7 MAY 1958

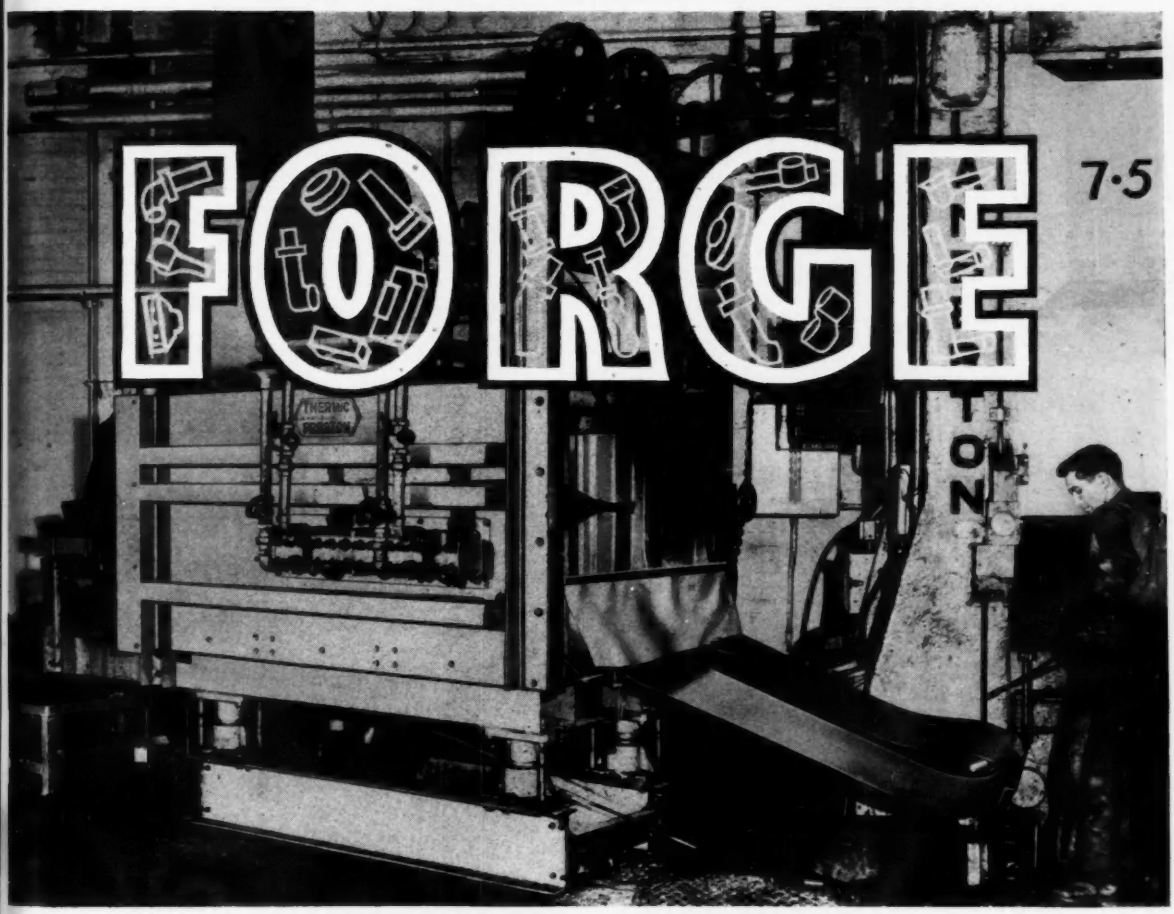
GAS IN INDUSTRY

Supplement to the "GAS JOURNAL"

Vol. 1 No.1

THERMIC

Mechanised



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GAS IN INDUSTRY

MAY 1958

Vol. I No. I

FEATURES

SERVICE FOR INDUSTRY IN THE WEST MIDLANDS

SPECIAL GAS PLANT FOR THE MANUFACTURE OF INSECTICIDES

RECENT DEVELOPMENTS IN THE USE OF GAS FOR THE CERAMIC INDUSTRY
—By K. E. Davis and L. Walker

THIS IS OUR LIFE
—By S. Heywood

GAS AT WORK IN INDUSTRY EXHIBITION IN DUBLIN

FACTORY EQUIPMENT EXHIBITION AT EARL'S COURT

LOSSES TO OIL OUTWEIGHED BY GAS GAINS
—By Richard M. Currie

THE HOLMES-MAXTED PROCESS IN INDUSTRY
—By James J. Priestley

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Editorial

Gas in the Potteries

THE growth over the last 20 years and the continued and by no means exhausted development of the applications of town gas in the ceramic industry of Stoke-on-Trent is surely one of the most encouraging phenomena in the position of the gas industry in these rather trying times. In all the heat-consuming processes of pottery manufacture it is claimed that town gas can give the best service. This claim has been, and still is, being put forward and maintained without slackening of effort and with conspicuous success. One gas-fired tunnel kiln in 1932 grew to 66 in 1939; 74 gas-fired kilns of all types consuming 1,344 mill. cu.ft. of town gas in 1939 grew to 272 kilns consuming 5,179 mill. cu.ft. in 1954. And Messrs. Davis and Walker, whose paper we report in later pages, tell us that the total amount of gas sold by the Stoke-on-Trent Undertaking of the West Midlands Gas Board in the year ended March, 1957, was over 10,000 mill. cu.ft., of which nearly 6,500 mill. cu.ft. was used for the firing of ceramic materials, representing 91% of the total industrial sales. The curve of development is now flattening out, but the continued existence of 600 coal-fired 'bottle' kilns is taken merely as a healthy challenge to further achievement.

This enormous and rapid growth in demand created a correspondingly great problem in the development of gas-making plant to meet it. Mr. J. E. Stanier, now Divisional General Manager of the North Staffs. Division, and formerly Chief Engineer and General Manager of the Gas Department of Stoke-on-Trent, has seen this development through on both sides, manufacture and application, and has been personally responsible for most of it, with the able assistance of one of the authors of the paper, Mr. K. Davis, Industrial Gas Officer of the North Staffs. Division.

In a paper which he presented to the Fuel and the Future Conference in October, 1946, Mr. Stanier set out the advantages which the use of town gas presented to the ceramic industry. Fuel economy was the most obvious. Here we should note, quoting from a Gas Council memorandum, that pottery requires heat in three stages: The moulded biscuit is dried and fired to temperatures from 1,050° to 1,250°C.; it is then dipped in glaze and the 'glost' fired to 1,020°-1,150°C.; and finally, after decoration, it is fired to 700°-750°C. The average ratio of equivalence over the whole process, says Mr. Stanier, is one therm of gas to four therms of coal, while at the 'glost' stage it is 1 to 8½. From the point of view of coal conservation town gas firing of the continuous tunnel kiln saves more than

A New Service to the Industry

This is the first of regular supplements to the *Gas Journal* dealing with all aspects of industrial gas. Our aim is to provide exclusive articles on matters of interest and importance to industrial gas engineers and companies using gas for all types of production processes. GAS IN INDUSTRY will appear in the first issue of the *Journal* each month.

two-thirds of the heat energy used in the coal-fired intermittent kiln. Better ware results from close and automatic control, spoilage is negligible, smoke and dust are eliminated. Labour costs are greatly reduced with vastly better working conditions, while yards and approaches are kept clear of ash heaps and dumps of solid fuel.

Naturally, the economy of the tunnel kiln over-shadows achievements in many other directions. It must be one of the most efficient of gas appliances. The goods are fired in counter-current to the combustion air or gases. The cold goods enter at one end of the tunnel while combustion air enters at the other, with the combustion zone in the middle. Thus the residual heat of the kilned goods is recovered in the combustion air while that of the combustion gases is used to dry and heat up the incoming goods. A by no means negligible further advantage is that as the wares come out cold there is a saving of time.

But Messrs. Davis and Walker describe a further refinement, in the development of the multi-passage kiln. Mr. Stanier had already pointed out that 'a kiln with a relatively small well-loaded truck, firing on the optimum cycle will be more efficient than a kiln of the same length firing the same output but with a larger truck and firing on a slower cycle.' This principle is developed in the multi-passage kiln in which the cross section is divided into a number of small passages.

The paper describes with a drawing and photograph a very interesting four-passage kiln which has been built to the designs of the Board at Longport by Gibbons Bros. In this case the wares are placed on 'bats' which are mechanically pushed through the 44-ft. length of the oven. It is claimed that in this kiln gas consumption has been cut down to 50% for the same output in comparison with the orthodox kilns—a revolutionary development indeed.

There are also a number of ancillary processes which, if less spectacular, are no less important in the preparation of materials in the industry which itself covers an immense range of goods from the finest china in the world to sanitary earthenware, electrical porcelain and high grade refractories. In intermittent as well as continuous furnaces and kilns town gas finds successful and economical application.

The paper was presented at a joint meeting in Stoke of the local Section of the Institute of Fuel and the North Staffs. Fuel Society and it was therefore not surprising that some of the questions raised in the discussion were a little unusual. For instance, one speaker asked why two famous potters, Wedgwoods and Mintons, were not using gas. 'Exceptions prove the rule,' may not be a completely satisfactory answer, but the fact is that users of town gas include many famous pottery firms—W. T. Copeland making the famous Spode china, Doulton Fine China Ltd., T. C. Wild & Sons, J. Aynsley & Sons, and Paragon China Ltd. among them. By the way, the authors describe a very interesting gas-fired continuous flint calcining kiln which is installed at the Wedgwood works.

The question about the competition of oil was inevitable. Fortunately industrial gas in Stoke is probably one of the cheapest in the country, so that the amount of oil firing in the ceramic industry is relatively small (it is said that only three firms are using oil for kiln firing); in some other processes quite a number of conversions from oil to town gas have taken place recently.

It is surprising that nothing was said about the presence of organic sulphur in town gas. We are told, however, that as a matter of fact organic sulphur is very low in the gas sent out from Etruria where there is considerable washing for benzole. The two supplies of coke oven gas which come into Etruria are both completely debenzolised—and this process has the effect of considerably reducing organic sulphur content. Low sulphur content is advantageous in many processes of firing in the ceramic industry but is rather vital in the firing of decorated ware.

But great as are the achievements of gas in the potteries there is no tendency to 'stand on them.' Development is going ahead to improve the construction of kilns, furnaces and equipment so that the ceramic industry may be served with the greatest possible economy in appliances equipped with controls both to ensure full protection from misuse and to provide complete control over the process cycle, with full use of electrotonic and other modern techniques. It will be interesting to see whether and how far this economy in the use of gas will lead to increase in the total gas demand.

SERVICE TO INDUSTRY IN THE W. MIDLANDS...

THE industrial gas service of the West Midlands Board, in whose area this load accounts for 50% of the total sales, with 10,000 users consuming 166 mill. therms per annum giving a yearly income of £9,350,000, is one of the most highly organised and fully developed departments in the country. In this industrial field the Board has vigorously continued the policy originally initiated by the Birmingham Gas Department a year or two before the first world war when, as it is interesting to recall, the first main drive for an industrial load was the laying down of a high-pressure gas main (10-12 lb. per sq. in.) to the jewellery quarter both for the purpose of supplying blowpipes and for firing small furnaces, this development being followed by the opening of an experimental foundry at the Windsor Street gasworks. The system of high-pressure gas firing never fulfilled the original expectations of its promotors in ousting the air-blast burner for high-temperature work, mainly because its employment required that the user should either be situated on a high-pressure gas main or else that he should instal a gas compressor many times more expensive than the type of fan or blower required for air-blast burners without the system showing any correspondingly marked advantage; but it nevertheless marked the beginning of several decades of increasingly successful development carried out for the industrial gas consumer.

Growth

An examination of the records of work done either by an industrial gas department or a furnace maker at that early period would show that gas was then regarded as chiefly suitable as a fuel for small oven or muffle furnaces, with a cautious approach from the brassfounding industry for melting furnaces of small capacity. The growth of the field is faithfully reflected in the increasing size of the furnaces to which gas firing was applied. Whereas in the early days a technical representative might spend weeks over securing the eventual installation of a small 8 ft. by 12 ft. by 6 in. muffle, there are today at

Operator galvanising a ship's mast head lamp over a gas-fired galvanising bath in a Birmingham works.

THE AREA WITH ONE OF THE MOST HIGHLY ORGANISED AND FULLY DEVELOPED DEPARTMENTS IN THE COUNTRY

work in this area oven furnaces up to and including one for billet heating 10 ft. by 120 ft. by 10 ft., working at a temperature of 1,250°C., and consuming an average of 50,000 cu.ft. per hour. Side by side with the steady progression in the size of plant is also to be noted the growing completeness of the equipment of the average installation which tends more and more to include pyrometer, automatic temperature control, push-button automatic ignition, and safety devices against either air or gas failure.

Focal Point

Today, Birmingham acts as the focal point for the industrial gas side of the whole of the West Midlands area. The Brasshouse Passage premises (Fig. 1) is utilised more particularly as a laboratory and workshop for the production of prototype plant, and the Adderley Street establishment (dating from 1955) is used for the heat-treatment of components, the plant for the purpose installed here including four furnaces with hearth area 5 ft. by 8 ft., two 4 ft. by 6 ft., a varying number of 3 ft. by 4 ft. and 2 ft. by 3 ft., together with hot-air circulating furnaces, quenching tanks, the latest control gear, as well as laboratory hardness-testing machines.

Melting Furnaces

Within the area of the West Midlands Board, Coventry has also been actively engaged in the development of the industrial load prior to the first world war, when considerable attention was given to the application of gas for melting furnaces, some of the results achieved in this early period being of interest even today. During the 1939-1945 period, the Coventry gas undertaking (as it was then termed) also set up a heat-treatment shop in Kenilworth, not only for the purpose of demonstration but also to undertake such work regularly for the small sub-contractors in the city who did not possess their own heat-treating plant. This establishment, which assumed major importance when production was being rebuilt in Coventry after the blitz, has now been transferred to premises in Abbotts Lane, Coventry. Here a considerable amount of work is done in cyanide case-hardening, whereas the Adderley Street establishment in Birmingham concentrates mainly upon pack-hardening.

The operation of an industrial gas service either by one of the old undertakings or by any of the present boards naturally raised some interesting questions of policy *vis-à-vis* manufacturers producing furnaces or similar industrial equipment. While the efforts of both result in increasing the sale of gas, the effective driving force and the approach is entirely different, and this can be best illustrated by the example of the installation of a simple type of oven furnace 2 ft. by 3 ft. by 1 ft. for some perfectly straightforward heat-treatment operation. From the furnace manufacturer's point of view this transaction represents an outright sale of a value a little over £200 and providing the process was one for which the furnace had been designed he would expect to hear nothing further of it. From the industrial gas service point of view, however, this transaction (even though they may not have heard of the nego-

tiation prior to the installation) represents an addition to their annual sale of some 1 mill. cu.ft. of gas (approximately £345). The difference in the point of view is even more striking in the conversion of an existing plant from oil or solid-fuel firing to gas. Such a case would for the average furnace manufacturer entail a lot of investigation, free advice, possible guarantees, and trouble for the eventual sale of possibly £20 or £30 worth of burners, while for the industrial gas department, against the preliminary investigation, possible experimenting and technical advice, could be set another annual increase of possibly 10 mill. cu.ft. It will be seen, therefore, that the gas department's interest in many transactions of this nature is vastly greater than that of a plant manufacturer.

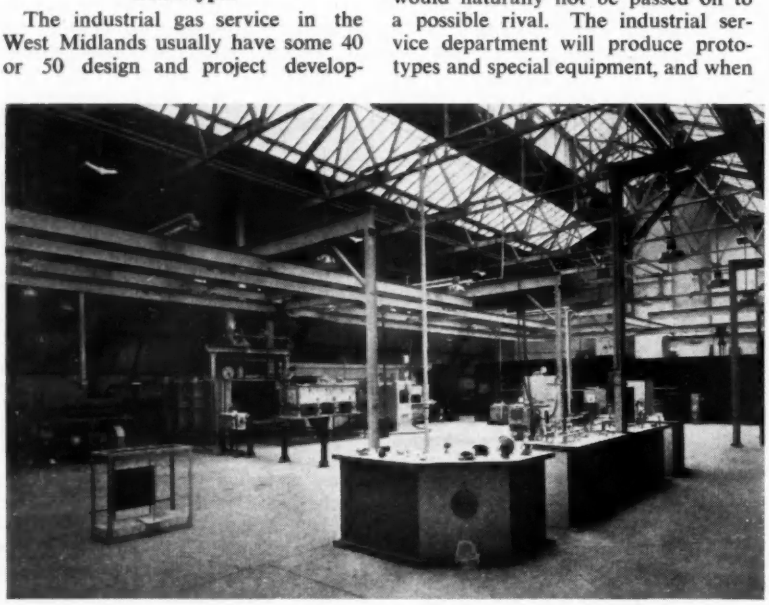
General view of the large furnace section at the Adderley Street (Birmingham) heat-treatment department of the W.M. Gas Board.

Achievements

In pursuance of the Board's policy of developing to the utmost the use of gas as an industrial fuel, their technical staff are continually working out customers' requirements, especially in the way of experimental work and conversions, and it will be seen from the foregoing considerations that they can afford to take a long-term view in connection with the preliminary work such as would be quite uneconomic for the average plant manufacturer, although the latter has many fine achievements to his credit in this interesting field.

Prototypes

The industrial gas service in the West Midlands usually have some 40 or 50 design and project developments on hand which have been undertaken on behalf of firms in the area both large and small. New designs and methods (which could be the subject of patents) are made available under licence to any plant manufacturer who may desire to make use of them, the only exception to this policy being when a working design has been evolved to meet some confidential process evolved by the user, in which case the ideas of such a user would naturally not be passed on to a possible rival. The industrial service department will produce prototypes and special equipment, and when any development of general application emerges, the policy is for this to be handed over to recognised furnace manufacturers who may be in a position to proceed to commercial exploitation. It will be seen, therefore, that the plant manufacturer possesses in such a service, without any cost to himself, a highly efficient laboratory and experimental shop staffed by a body of technicians operating continuously throughout the most industrialised area in the whole of the United Kingdom, and whose results and findings are regularly available to him. The potential user, with any problem which is capable of solution by the use of gas, can avail himself immediately of the services of this staff by merely contacting any gas office or showroom in the area.



One end of the development laboratory at the industrial department headquarters, Brasshouse Passage, showing in the foreground display tables with flame-failure devices and in the background prototype units of various types in course of development.

Experience

In this connection, it will have been noticed that the Board is a substantial user of its own product for industrial purposes upon strictly commercial lines, so that its scientists and technical officers can in no way be reproached with working in a scientific vacuum divorced from commercial considerations. The heat-treatment work carried out at Adderley Street, for example, which is invoiced to clients upon a strictly commercial basis, always has sufficient work in this line to keep it working a 16-hour day and a 5½-day week, so that the first-hand commercial experience in this field is considerable.

Special Gas Plant for the Manufacture of Insecticides

FLUOROACETAMIDE is now being prepared in substantial quantities for use in the manufacture of the 1% solution known as Tritox, used as a systemic insecticide for the destruction of aphid pests of non-edible plants.

Fluoroacetamide itself is a white crystalline solid of m.p. 110°C. and is freely soluble in water.

The manufacture of fluoroacetamide is based on the reaction between potassium fluoride and chloroacetamide by refluxing these together in a high boiling inert solvent, followed by entrainment distillation which removes the fluoride amide from the traction mixture. On cooling the distillate, practically pure fluoroacetamide, separates and, after filtration, this is dried at low temperature and the filtrate is then returned to process; after many re-uses, the solvent may be recovered by distillation in the usual manner.

For various reasons, it was decided that the fluoroacetamide plant should be gas heated in preference to being heated by steam or electricity. Further, in order to 'automatise' the plant as much as possible, it was decided to make use of special automatic gas-heating apparatus designed by the North Thames Gas Board.

The still seen in Fig. 1 consists of a stainless steel vessel, fitted with agitator and alternative water reflux and air distillation condensers with interlocked controls; an oil jacket is fitted with vent and combined oil filler and overflow. This is heated by automatic gas plant comprising a constant pressure governor, a rod-type thermostat in the oil operating on a remote relay valve, a Thermo-perl protective device and a clock control; this enables the heating to come into operation and to shut off completely at any predetermined time and to shut down on its thermostat at the desired temperature.

In the event of a failure of the pilot flame, the controls automatically set to the safe position. The same controls, with the exception of the rod-type thermostat, are fitted for preheating the solvent in the feed tank, which is a 60 gal. steel vessel, lagged; in this case an Aric instrument is fitted—this is a thermostat incorporating a dial thermometer which can be pre-set for cut-off at any desired temperature within its range. This device is sensitive to within 1°C. on either side of its setting, and is shown in Fig. 2.

Continued on p. 16

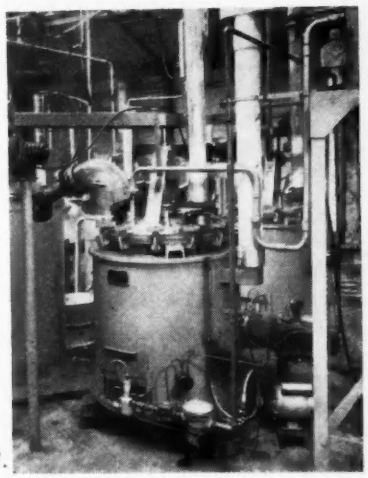


Fig. 1.

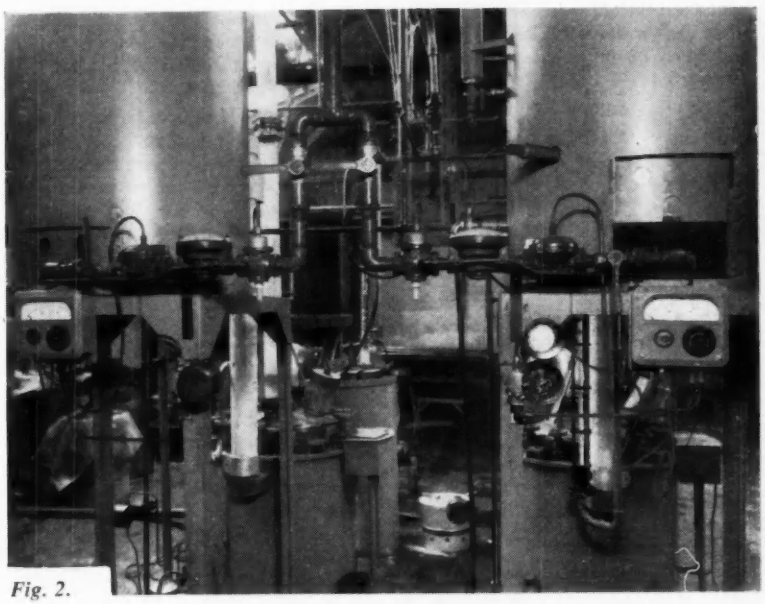


Fig. 2.

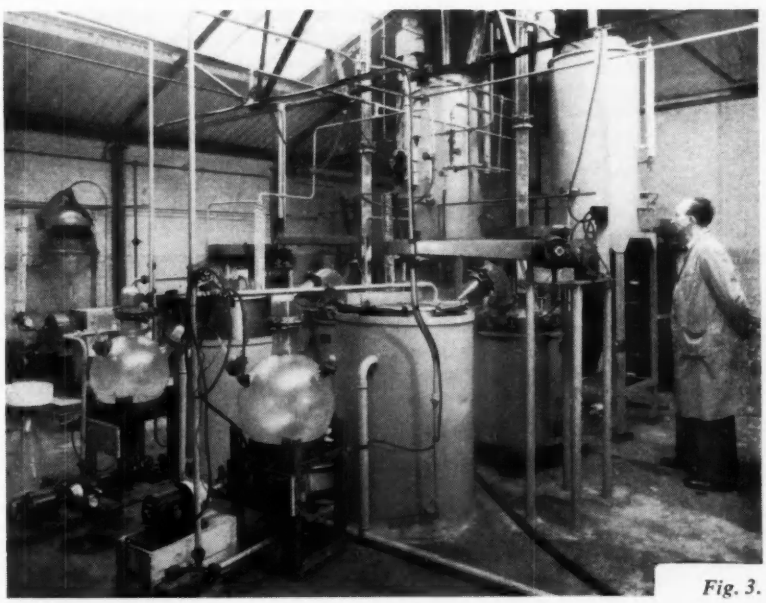


Fig. 3.

The Use of Gas for the Ceramic Industry

By K. E. DAVIS, M.Inst.Gas E., M.Inst.F.,
Divisional Industrial Gas Officer, North Staffs Division

and

L. WALKER, A.M.I.Mech.E., A.M.Prod.E., A.M.Inst.F.,
Engineer, Industrial Department Headquarters, W.M.G.B.

THE Stoke-on-Trent undertaking of the West Midlands Gas Board embraces the extensive works at Etruria, quite close to the original factory of Josiah Wedgwood and supplies gas for domestic, commercial and industrial purposes, to the six pottery towns.

The total amount of gas sold by this large undertaking in the year ended March, 1957, amounted to over 10,000 mill. cu.ft. Of this total over 7,000 mill. cu.ft. or approximately 73% was used for industrial purposes. Nearly 6,500 mill. cu.ft. of gas was used exclusively for the firing of ceramic materials, this figure representing 91% of the total industrial gas sales. A large proportion of the remaining 9% was used for ancillary ceramic processes such as frit firing, clay drying, colour firing, bone calcination, etc. The developments which have occurred in the potteries during the post war years have imposed a considerable demand on the Board to keep pace with progress. In 1945 gas used for the actual firing of ceramics amounted to just under 1,250 mill. cu.ft. thus since the end of the war the consumption of gas for this purpose has increased over five times. In 1953 approximately 5,500 mill. cu.ft. was sold for industrial processes and in the past four years this figure was increased by over 30%.

More Economical

The ceramic industry to-day uses town gas for all processes requiring the efficient application of heat, such as clay and ware drying, flint and bone calcination, frit melting and all types of firing embracing biscuit, glost and decoration of both china and earthenware domestic pottery, glazed and floor tiles, sanitary earthenware, fireclay sanitary ware, electrical porcelain and high grade refractories. When the advances made by the ceramic industry since the end of the war are considered it is only fitting that comparable progress should have been made in the methods of firing adopted and today, more than ever before, manufacturers are installing new plant to procure more economical and efficient production.

Since the introduction of the Clean Air Act many sections of industry have been obliged to consider the use of a clean and efficient fuel for their heat requirements.

The prime cost of fuels today is undoubtedly high but the cost of labour has also increased considerably. If the advantages to be gained from the use of clean fuel are taken into account, then the difference in prime costs would be greatly reduced if not completely eliminated. Town gas is supplied having a constant calorific value, it is always on tap and its use ensures the absence of dirt and smoke, reduction in labour requirements, ease of temperature control, higher efficiencies of application and considerable reduction in the percentage of rejects. In addition to these advantages, the psychological effect on the workers, due to the improved conditions and cleanliness in the factory should not be overlooked.

It is generally conceded that the continuous orthodox type of tunnel kiln has, up to the present, been the most efficient means of firing. However, several factories in the area, owing to the restricted space available, would have extreme difficulty in installing this type of kiln of standard length In any case a very large capital outlay would be involved. These factors, together with the need today for considerable degree of production flexibility to meet economically the fluctuating demand, have led many manufacturers to adopt shorter continuous ovens or alternatively the intermittent method of firing. It is very evident that this flexibility greatly assists in reducing output in accordance with the fall in demand, without running large scale plant at uneconomical loadings. There are still in use in the potteries today, some 600 coal fired 'bottle ovens' and the West Midlands Gas Board is ever conscious of the potential load available from these manufacturers.

From a paper presented to a joint meeting of the Institute of Fuel and the North Staffordshire Fuel Society, March 11.

An efficient burner should be capable of consistent operation, often at high temperatures and have a turndown range suitable for the application. The usual manner of expressing the turndown range is the ratio: Maximum gas rate/gas rate at lower limit of stability.

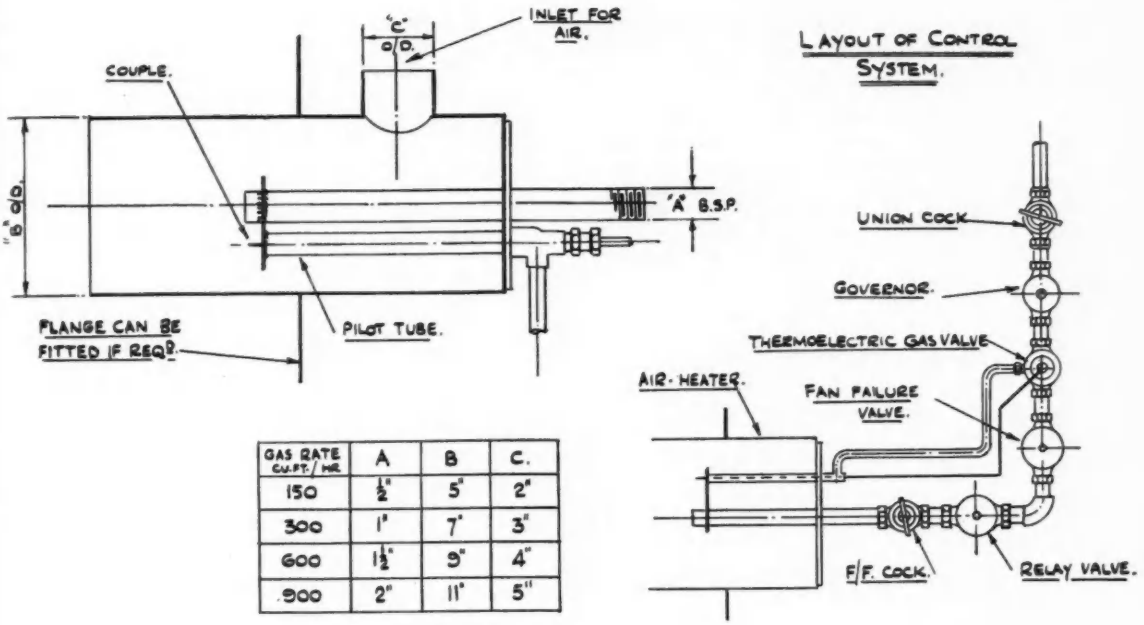
Suction Burner

Post aerated burners range from small single jets having very low consumptions, to large burners of the Hypact type capable of handling consumptions of several thousand cu.ft. per hour. For forced circulation ovens and large air heaters, etc., the suction burner of the type manufactured by Keith Blackman is employed. These burners are available in capacities up to 6,000 cu.ft. per hour and under normal conditions are suitable for operating with a suction of up to ½ in. w.g. Spark ignition and electronic flame failure equipment is usually incorporated and the system arranged to provide a purge period between the commencement of the operation of the fan and the admission of gas.

For similar duties the Board's Industrial Department has developed a very simple air heater which is shown diagrammatically in Fig. 1. This consists essentially of a neat gas burner contained within a fabricated housing which is fitted with an inlet to receive air from a low pressure blowing fan, usually at a pressure of approximately 3 in. w.g. and again protection against flame failure or fan failure can be provided.

For use with the pre-aerated type of burner, several proprietary makes of injectors are available. Of these the new pattern, recently introduced by Amal Ltd., is an excellent example and with this particular injector, aeration of the order of 2½ to 1 is obtained in the mixing tube.

Air blast burners employ air under pressure, normally between ½ and 2 p.s.i. and gas at normal low pressures. The air passes through a suitable injector entraining the requisite amount of gas and the mixture is fed forward to supply either a single burner or a



GAS RATE CU.FT./HR.	A	B	C.
150	½"	5"	2"
300	1"	7"	3"
600	1½"	9"	4"
900	2"	11"	5"

Fig. 1. Diagrammatic arrangement of air heater.

number of burners on a common manifold. All the air required for combustion can be introduced in this manner and the dependence on secondary air ports and flue pull in the setting is entirely eliminated. The setting can be slightly pressurised to avoid entry of air through observation ports, cracks, ill fitting doors, etc. With this system combustion conditions of reducing or oxidising atmospheres are pre-set and maintained, higher flame temperatures are achieved together with a high heat release per unit volume of combustion chamber.

As an alternative a mixture controller which incorporates a suitable injector, gas valve and atmospheric governor in one assembly, can be utilised. Fig. 2 shows diagrammatically a section through the Type 3 mixture controller manufactured by Keith Blackman. This controller is available in four sizes, having capacities from 290 to 1,530 cu.ft. of gas per hour at air pressures of 1 p.s.i.

The mixture pressures obtained with air blast burners would normally cause the flame to leave the burner port and some means of flame retention must be provided. Where the burner is positioned in the wall of a setting it is normal to utilise a tunnel for this purpose but where this is not possible or it is undesirable to utilise a tunnel, then other means of flame retention have to be adopted. Special heads of various designs are now available for this purpose, the primary object being to provide a stream of low velocity mixture around the periphery of the burner port, which serves to retain in position the main stream of high velocity mixture.

Air blast burners tend to be noisy in operation and several attempts have been made to reduce this noise. One method is to distribute the burner port area required over a number of small drilled holes and several burner heads of this type have been made using a refractory material known as Agalain, which can be machined and drilled prior to firing. Another interesting application of the air blast technique is the Target gas burner introduced into this country by Dowson & Mason. There are two distinct types.

(a) The tricentric burner for use in the open or in closed combustion spaces.
and
(b) The bicentric burner which is recommended only for use in the open.

Both types are available with single or multiple burner heads, the size, type and shape of burner head varying according to the application on hand.

Fig. 3 shows the diagrammatic

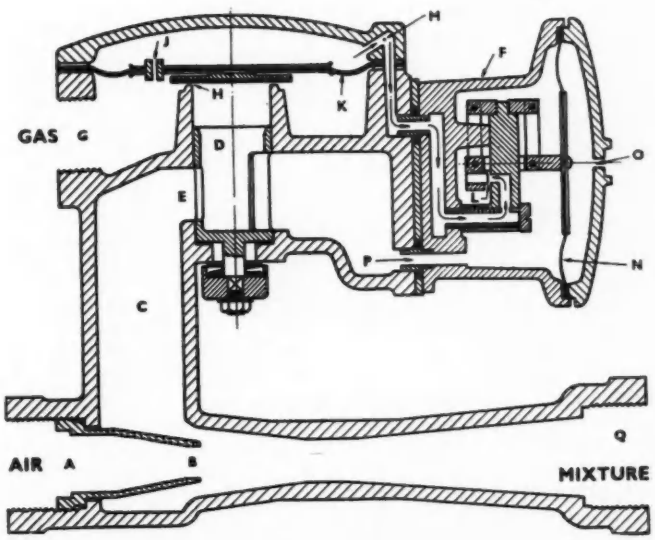


Fig. 2. Type 3 mixture controller—Keith Blackman, Ltd.

arrangement of both types of burner; the tricentric type has two distinct chambers, one of which conveys gas/air mixture and the other secondary air only. Each inner chamber consists of a nozzle through which the rich gas/air mixture passes at high velocity and an annulus through which part of the same gas/air mixture is fed but at a lower velocity. The low velocity flame is cross connected to the high velocity flame by two slots which are also utilised to assist assembly. Surrounding the annulus referred to is an outer annulus through which the secondary air for the completion of combustion is supplied. With this arrangement it is possible to alter the relative sizes of the jets incorporated, so modifying the shape and type of flame obtained. The secondary air also acts as a cooling medium and enables the burner head to be placed well within the brickwork assembly of a setting.

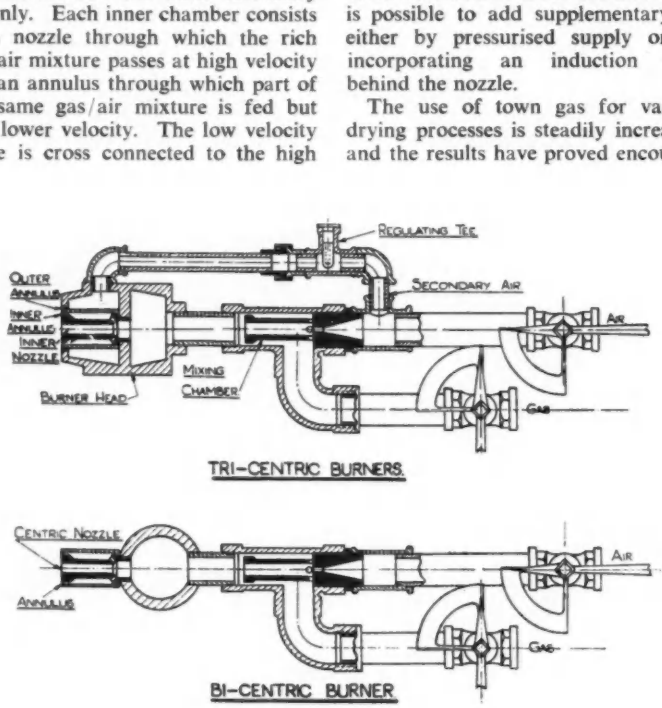


Fig. 3. Target burners.

The bicentric are essentially the same as the tricentric type except that the surrounding atmosphere supplies the secondary air. Each burner jet, therefore, has the characteristics of a non-blow-off tip of the type previously referred to.

Medium and high pressure burners, when applied to kilns, are usually of the post-aerated type. Gibbons Bros. have in particular applied this type of burner to several conversions, the burners operating with a gas pressure of approximately 1 p.s.i. Depending on the application, the burner is available with a refractory nozzle or alternatively with a heat resisting steel nozzle. Rapid combusion is achieved with this type of burner due to the high velocity of the gas stream and the air for combustion, which is entrained from the interior of the kiln, being extremely hot. In many instances all the air for combustion could be obtained in this manner but it is possible to add supplementary air either by pressurised supply or by incorporating an induction slide behind the nozzle.

The use of town gas for various drying processes is steadily increasing and the results have proved encouraging. Many of the drying stoves still in use in the industry are of the brick built walk-in type, usually heated by means of a stove pot or coils of steam pipes. In such stoves the humidity is usually very high and the air movement practically nil, resulting in an excessive time required for drying. This type of stove dates back to the days when practically all the power requirements of the factory were derived from steam driven plant and ample steam was available, either as exhaust from the power plant or as surplus steam from the boiler plant. As steam driven plant has now largely been replaced by other means of motive power, boiler capacity has become in excess of requirements and the operation of boilers is now uneconomical from the point of view of fuel consumption, especially in the summer months when space heating is not required.

Before leaving this section it must be stressed that wherever air is used under pressure in conjunction with town gas, it is essential that a back pressure valve should be provided in the gas supply.

The Board has co-operated for some time with various manufacturers of drying equipment with regard to the adaption of gas heating for both continuous and batch type driers. The products of combustion from the gas fired heater are drawn into a recirculating hot air system supplying the drier, only cool and comparatively saturated air being exhausted from the drier. For many years drying operations have been carried out in the 'stillage' type drier which consists of a brick built room of appropriate size, with steam or hot water pipes maintaining a temperature of approximately 96°F. Following co-operation between Casburt of Fenton and the Board, a prototype recirculating oven was built using a suction type air heater. Although the oven was comparatively small, sufficient encouragement was obtained from its performance to prompt the manufacturers to decide to build a production size unit. This oven was an immediate success, drying times were more than halved, floor space was saved and labour costs considerably reduced.

Direct Fired

At another large works in the city the Board has recently assisted in replacing a very large indirect gas fired heater with a modern direct fired unit. The heater is used for the drying of clay ware in moulds in a continuous drying oven and the change has resulted in a reduction in gas consumption from 3,500 cu.ft. per hour to 2,100 cu.ft. per hour for the same output.

Flint calcining in the Stoke-on-Trent area is still largely carried out in intermittent coal fired kilns. The performance of these kilns has been fully reported by the British Ceramic Research Association. Each kiln holds approximately eight tons of flint and uses between ten and 15 cwt. of coke or coal per firing. Using the lower value a figure of 137 lb. of flint calcined per therm of fuel used, is obtained.

A very interesting continuous flint calcination process is being carried out in the works of Josiah Wedgwood & Sons, of Barlaston. This plant shown in Fig. 4 consists of a vertical shaft, firebrick lined, 21 ft. high by 2 ft. diameter. The firebrick is backed with insulating material and the whole shaft is encased in a mild steel shell having an outer diameter of 3 ft. 9 in. The uncalcined flint is fed into the kiln through a hopper device at the top, the hopper being filled from an overhead supply bunker. The calcined flint is removed continuously from the bottom of the kiln by means of a vibrator and dropped into a collecting hopper before being conveyed to the crushers. Gas burners of the natural draught type fire into an annular space around the kiln and two

additional sets of burner ports are provided lower down the kiln in case further heating is necessary and also to introduce pre-heated air if required. The exhaust gases, after having passed through the flints, are extracted through a 9 in. flue at the top of the kiln by means of an exhaust fan. A fresh charge of flint is introduced into the kiln every half hour. Providing the raw material is 2-3 in. in size, blockages are very infrequent and due to the uniform conditions, calcining is carried out at a temperature much lower than that experienced in intermittent firing and is, in fact, about 750°C. The quantity of flint produced hourly is approximately 440 lb. with a gas consumption of 326 cu.ft. This works out at 7.8 therms of gas per ton of flint calcined or alternatively, 287 lb. of flint per therm. The advantages gained with the gas fired continuous kiln are obvious; the flint is evenly calcined throughout, is perfectly clean and uniform, the specific gravity is constant and the danger of silicosis to the men operatives is very much reduced as they do not in fact handle the flint.

Glazes for application to pottery usually contain finely ground lead and borax glasses, known in the trade as 'frits.' The frits are made by heating a mixture of pure minerals containing silica and alumina together with fusible elements such as lead, boron and alkalis. The heating is carried out at 1,100-1,400°C. according to the particular type of frit and the furnaces are usually of the reverbatory hearth type or rotary type. Both types are operated intermittently, that is a batch of frit mixture is placed in the furnace, heated for approximately three to four hours and then run off and the furnace re-charged. When the molten mass is run off it is quenched in water to granulate the constituents.

Increased Output

A number of the reverberatory hearth type furnaces have recently been converted from coal firing to town gas, one in particular had hopper feed from the floor above and internal dimensions of 11 ft. 9 in. by 3 ft. by 2 ft. 6 in. to the crown of the arch at the point of run off. The coal fire mouth was completely removed and a self proportioning burner having a maximum capacity of 2,500 cu.ft. per hour was mounted centrally on the bridge wall. Air for combustion was supplied from a low pressure blowing fan at approximately 10 in. w.g., the air being pre-heated to a temperature of approximately 160°F. The increased output, of the order of 23%, obtained with town gas over a given working period is due to the time saved by the elimination of temperature fall arising from clinkering, etc. With town gas the atmosphere in the kiln is constant at all times, resulting in a very uniform product, completely free of contamination by ash or sulphur. With coal firing the bottom and side walls of the setting required repairs every four weeks while the main arch had to be repaired approximately every 12 weeks. These figures were increased to 13 weeks and 36 weeks respectively when town gas was used.

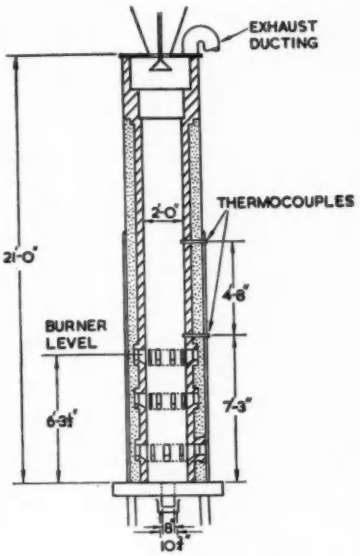


Fig. 4. Gas fired flint calcining kiln.

A continuous type of frit melting furnace has recently been put into production by W. Podmore & Sons, of Caledonian Mills, Stoke-on-Trent. The Podmore type kiln, which is considerably longer than the normal reverbatory hearth kiln, was developed and built within the Podmore organisation, following co-operation with the Board's industrial staff. The kiln has a sloping bottom, the frit mixture after melting flows through in a shallow stream to the lower end where it is continuously discharged, cooled and granulated by a high velocity stream of water. After being de-watered the frit is dried by a direct gas fired air heater and packed on automatic plant. The advantages of this type of kiln result principally from the exceptionally long life of the refractory lining. This factor contributes towards the low cost of kiln maintenance and accounts for the very high and uniform quality of the product.

In the production of lead frits the general practice is to use red lead as a constituent of the frit mixture. The highly developed plant operated by W. Podmore and Sons used pig lead, the metal being reduced to a fine powder and then oxidised by the waste heat from the frit kiln. This contributes to the quite exceptional efficiency of the process. A heat exchanger is used to cool the products of combustion to approximately 100°C. and to pre-heat the air for the burners to approximately 250°C. The rate of output from the plant depends upon the characteristics of the particular frit being processed but for a standard type lead bisilicate frit the output is up to 20 tons per day. The gas consumption for the production of one ton of lead bisilicate frit including the melting and oxidisation of the lead, fritting and drying, is not more than 30 therms, giving an overall figure for the whole process of 72 lb. of frit per therm.

Intermittent Kilns

The flow diagram for this very interesting plant is shown in Fig 5 and indicates how the waste heat from the melting furnace is used for pre-heating the frit mixture, for oxidation of the finely divided metallic lead and finally for pre-heating the combustion air. The temperature of the products entering the waste stack is approximately 100°C.

The pottery industry was quick to

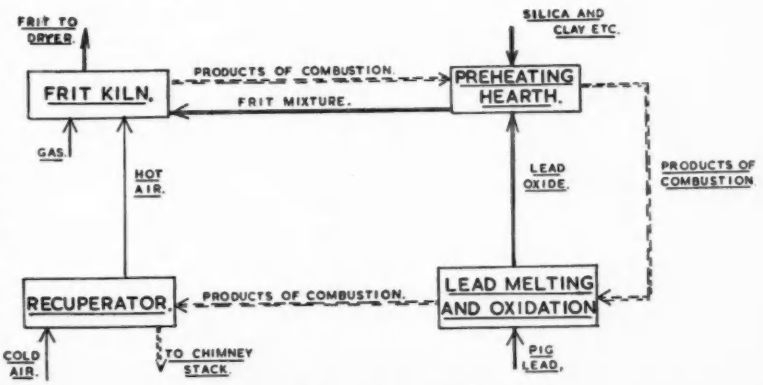


Fig. 5. Flow diagram—frit melting.

appreciate the advantages of tunnel kilns over the old inefficient fired bottle ovens, and no doubt the very wide difference in performance of the two methods helped to foster the feeling that continuous firing was the best and most efficient method of production. It has always been conceded, however, that large tunnel kilns must be run at or near maximum pay load conditions to ensure efficient operation. Recently it has become increasingly evident that changes in market conditions outside the control of the industry often make this impossible and many manufacturers have turned to more flexible methods of production. The use of shorter tunnel kilns or a number of intermittent units gives the desired degree of flexibility, and it was obvious that many of the disadvantages associated with the old bottle type ovens would not be met with in the modern gas fired or electrically heated intermittent kiln.

Types

(a) *Box Type.*—Which is usually set and drawn by carrying the ware and setting materials in and out of the chamber, although of course on very large sizes the ware may be mechanically loaded.

(b) *Truck Type.*—Here the ware is placed on a bogie or truck which is then pushed into the kiln, fired and withdrawn.

(c) *Portable Cover or 'Top Hat' Kilns.*—In this type the ware is placed on a fixed base whilst the cover is raised out of position. Generally it is the practice to use one cover to serve two bases, the cover being transferred from one to the other, usually at a temperature of approximately 300°C. which obviously improves the overall economy.

Relative Merits

The relative merits of these three types of kiln have been discussed several times previously, and opinion still seems to differ widely as to which is the best, particularly with regard to the last two. The truck type is placed and off loaded at convenient positions and times to suit other operations, while in the case of the portable cover kiln, it is considered an advantage that the ware, after placing, is not moved either prior to or during the firing.

The size and type in the box type kilns class varies considerably. Several very large open type settings have been built for firing electrical porcelain components. The internal dimensions of these kilns is of the order of 24 ft. by 14 ft. by 14 ft. high and fire to a temperature of approximately 1,230°C. in 60 hours. The maximum gas rate, depending on the size of the setting, will be of the order of 10,000 cu.ft. per hour and a total consumption for the full firing cycle would be approximately 400,000 cu.ft. The insulators are sprayed with glaze in the clay state and are once fired. Very even temperature conditions are obtained throughout the setting and the burners are of the nozzle mixing type, using gas at normal mains pressure and air at approximately 6-8 in. w.g.

Gas fired truck type intermittent kilns are usually heated by means of air blast burners arranged to fire beneath the truck top tiles. In a typical kiln of this type two trucks are used and the overall placing space is 10 ft. by 2 ft. 6 in. by 4 ft. The products of combustion circulate freely through the load and are drawn off via the flues arranged on either side of the setting into a common flue running along the top of the kiln. The lower of the two dampers shown is opened at the end of the firing cycle to provide more rapid cooling than would normally be obtained. Hot face insulating material was used wherever possible in order to reduce the thermal capacity of the setting and as mentioned earlier the type of burner used can be pre-set to give the desired atmosphere. The kiln has been used on an experimental and semi production basis for the firing of china biscuit to 1,250°C. over 32 hours. Results of these firings show that the cost of firing would compare very favourably with that for a similarly sized electrically fired kiln.

Cover Kilns

The use of portable cover kilns with gas fired settings is not new. This principle has been used for many years in the heat treatment of metals. The Board is, however, actively interested in the development of cover kilns for the pottery industry and in addition the East Midlands Gas Board has recently constructed a setting for the firing of earthen sanitary ware. This kiln has an effective placing space of 11 ft. 9 in. by 3 ft. 9 in. by 5 ft.

Following co-operation with James Davies, the well-known colour manufacturers, a small portable cover setting was built for the intermittent firing of ceramic colour.

The colour was previously fired in a coal fired kiln holding 60 saggers, the setting being raised to 1,300°C. in 14 hours, using between 24 and 30 cwt. of coal at £5 9s. 0d. per ton. The gas fired kiln is fired to 1,200°C. in 10 hours or 1,300°C. in 12 hours, according to the type of material being fired. Again the kiln holds 60 saggers, each sagger weighing 16 lb. and holding up to 25 lb. of material. The gas consumption for the lower temperature is approximately 70 therms and 80 therms for the higher temperature. Thus with gas firing the cost of fuel is nearly halved and in addition a far superior product is obtained, with less supervision during firing. Originally only one base was constructed but a second is now in preparation and this will contribute towards a reduction in gas consumption.

Multi-passage Kilns

With conventional tunnel kilns having large cross sectional areas there is always the possibility that the actual firing cycle for the individual pieces will vary according to their positions on the trucks. Long tunnels are normally required to ensure that all pieces are adequately soaked to reduce the effect of the differing conditions. Thus it follows that if the cross section is divided into a series of small passages and these passages are suitably heated, the possible variation in temperature will be reduced and the shortest possible firing cycle can be adopted with consequent improvement in kiln efficiency. This is achieved in the multi-passage kiln which, as its name implies, consists of a number of work passages through which the load is pushed on suitable refractory bats. The development, on the Continent, of an electrically heated kiln of this type was watched with interest both by potters and kiln manufacturers and following its success there its adoption in this country was inevitable. The seriousness of the possible competition from this type of kiln was appreciated by the gas industry and the West Midlands Gas Board concerned itself with the development of a gas fired counterpart.

In the electric kiln the load is moved in opposite directions in alternate passages in order that the heat given off by the outgoing ware in one passage can be used to pre-heat the incoming ware in the passages above and below. While this feature improves the thermal efficiency of the setting it has the distinct disadvantage that equal cooling and firing curves are essential. In addition a pusher mechanism has to be provided at both ends of the kiln, also fired and unfired ware has to be handled at two positions. With this arrangement it is difficult to arrange a smooth flow production line through the kiln bays. A further disadvantage of the contra flow operation is the importance of ensuring uniform loading of the bats to prevent temperature fluctuations.

When developing the gas fired kiln

it was evident that the contra flow of combustion products and load would lead to high efficiencies and further, that it would be possible, with obvious advantages, to have the load moving in one direction only. With developments of this kind discussions are usually held with both potential users and manufacturers. Close co-operation with Gibbons Bros. led to the construction of small experimental firing sections at Birmingham and this work was followed by the erection, by Gibbons Bros., of a three-passage kiln for the firing of general earthenware glost.

Experimental

Work in the Board's Development Section was concentrated on providing a simple and efficient burner system with a means of controlling the distribution of heat release in the firing zone. This was considered necessary in order to provide variations in the temperature gradient near the peak of the curve. Early experimental work was carried out in a very small setting, the arrangement consisting of a simple combustion chamber and neat gas burner, with provision for admitting the air for combustion at a point adjacent to the burner and also at various positions along the length of the setting. The burner was supplied with a deficiency of air for complete combustion and the balance admitted at one or more of the points along the setting, thus a means of controlling the temperature gradient was obtained, since a rise in heat input occurred where the air was admitted and allowed a further approach towards complete combustion. These experiments proved that with one single burner a uniform distribution of heat release, over a distance of some 5 ft., could be obtained. The next stage was to build a larger experimental setting comprising a firing zone for a four-passage kiln of the muffle type. Each work passage was heated from above and below by a combustion chamber. The setting was subjected to artificial loading by passing air along the work passages in order to obtain operating data and following extensive tests work was commenced on the design of a full scale operating unit.

On the completion of the drawings a contract for the erection of a prototype kiln was placed with Gibbons Bros. who built the first Gottignie multi-passage kiln in this country. In order that the unit would be available for inspection and trials by all interested parties it was decided that the kiln should be located on the Gas Board's premises, and the site chosen was the holder station at Longport. No special foundations etc. were required the production of the kiln proceeded smoothly. The ware is fed through the kiln on refractory bats, the bats being pushed end to end in the conventional manner by means of a hydraulically operated variable speed pushing unit. The fired ware and bats are discharged on to a receiving table at the off-take end, from which they are then manually removed. The four passages are heated by means of six combustion chambers positioned above and below the work passages. The ware is moved in one direction only through the kiln, contra to the flow of the combustion products, and this greatly simplifies the problem of arranging the pushing and receiving units.

The kiln comprises three main sections:

1. *Pre-Heat Zone* where the outgoing waste gases are used to preheat the incoming ware.
2. *Heating Zone* where peak temperature is achieved with facilities for controlling the distribution of heat.
3. *Cooling Zone* where the outgoing hot ware is used to preheat the secondary air for combustion and also if necessary the contravec air.

Effective Lengths

The burner arrangement comprised tubular refractory burners fitted with Amal low pressure injectors. The amount of air supplied through these injectors is just sufficient to prevent the town gas from cracking and the balance of air is supplied either as secondary only or as a combination of secondary and tertiary. If necessary the positions of the burners may be altered within the heating zone and this affords a means of easily varying the effective lengths of the pre-heating and cooling zones. The burners are inserted from one side of the kiln in this instance but with a setting having four passages in width, the burners would be arranged in both sides of the kiln.

A low pressure fan is used for supplying the secondary air for combustion at a pressure of approximately 2 in. w.g. and it is also utilised to supply, if necessary, contravec air which can be blown down the work passages. In addition to admitting this contravec air, control of the temperature and volatiles within the work passages is facilitated by the introduction of a series of suction ducts located along the length of the kiln, each duct being provided with individual damper control. The off takes from these ducts are connected to a main trunking running the full length of the setting which in turn is connected to the exhaust fan. This fan also serves to extract the waste gases from the manifolds positioned at the end of the individual combustion sections. If the load passing through each passage is identical then it is possible to control all four passages by means of one thermocouple positioned in the firing zone of one of the passages. This couple, used in conjunction with a conventional indicating controller, can be used to operate solenoid valves in both the gas and air supplies. It is anticipated that providing the cycle is the same throughout the passages, the passages could be operated at differing temperatures. In this case individual control of each passage would be employed and modifications to the manifolding of the gas and air supplies would be necessary. The hydraulic pusher and the receiver are both self contained units, mounted on wheels so that they may be quickly withdrawn from the kiln during any emergency. In order to cater for any slight variation in height, both units are provided with wooden wedges to facilitate adjustment.

Fairly extensive trials have been carried out on the firing of differing types of ware for various manufacturers, and although in some instances a few difficulties have arisen, generally speaking the kiln has come well up to expectations.

Encouraged

In conclusion it is hoped that at least some of the material presented has been of interest and that it has indicated the wide field of application of gas in the ceramic industry. Those engaged on the industrial side of the gas industry are encouraged by the improvements both in performance and appearance of the gas fired plant installed during the past few years. This trend must and will continue in the future, and it is pleasing to acknowledge the part played by plant manufacturers in this direction. It is felt, however, that there is still a large amount of plant manufactured by the small odd jobbing type of concern, and this equipment is often neither pleasing in appearance nor efficient in operation. The selection of the most suitable type of refractory material to be used in a setting now receives more consideration, and the industry was quick to appreciate the advantages to be gained from the use of hot face insulating material particularly with regard to intermittent kilns. Grades of this material are now available for face temperatures in excess of 1,500°C., and it is hoped that still better

qualities will be produced for operation at higher temperatures.

Work is proceeding in several directions towards the development of even better burner systems, and no doubt applications for these will be found as and when they become available.

DISCUSSION

Dr. C. Temple (International Furnace Equipment Co., Ltd., Aldridge): We have heard there are 600 coal-fired bottle ovens. I wonder if the authors would give us some idea of the proportion that 600 represents of the total number of ovens operating in the area. Can they tell us whether elctricity competition is serious and, finally, whether there is serious competition from oil?

Mr. Davis: I cannot tell you the proportion in use. Before the war, the pottery industry used 1 mill. tons of coal for pottery firing. About five years ago a statement was issued by the British Pottery Manufacturers' Federation that this amount had been reduced to 400,000 tons, by the use of gas and electricity. I reckon that figure is now in the region of just over 300,000 tons. It looks as if we have replaced about two-thirds of the coal-firing in the Stoke-on-Trent areas by other means of firing. There is competition from electricity in some fields, particularly in the firing of decorated ware. We have a number of gas-fired decorating plant. I don't know any electrically-heated continuous ovens firing biscuits. As regards oil, from the gas industry point of view, over the last few years, we have taken some load from oil to town gas. To my knowledge there are about three firms in the city who are operating with oil.

Mr. A. Dickens (M.E.B.): But the most famous factories have continuous firing by electricity.

The Chairman: You are referring, of course, to Mintons and Wedgwoods.

Mr. Dickens: Yes.

Mr. T. A. Devonport (Downings Tileries): I wonder if you have any experience of gas-fired intermittent kilns in the heavy clay industry? To particularise, have you any information on gas-firing under producing conditions in such a kiln? There was a slight mention of producing conditions, and I know there has been something done on the firing of blue bricks with town gas. Do you think it could be done, not necessarily for blue bricks, but ordinary bricks? Do you think you would be able to supply works in this area with gas for this?

Mr. Davis: I have no experience of gas-firing of bricks. Unfortunately, the end product is so cheap that you cannot afford a refined fuel to do such a job. As regards supplying the gas, we could not take many of that sort on at present, but I would like to take a few on. It would depend on their position. If we had mains handy, the capital cost of running them would not be so great, but if you have to run a mile or two with mains, the capital cost might be too great.

Mr. A. C. Jennings (Industrial Officer of the West Midlands Gas Board): I have two points. First the question of firing roofing tiles. I don't know what the figure of coal consumption would be for a ton of tiles, but it would be of the order of 3 cwt. of coal per ton of tiles. If you are talking in efficiencies of that sort, and if we can obtain the same efficiency as quoted in the paper with the multi-passage kiln, we could take it with the present price of coal. At the moment we are in the infancy of the multipassage kiln. On the question of oil, a lot of oil is being used in the ceramic industry, and I think there is a future for oil in the firing of ceramics.

Mr. Dickens: Why is so much attention and time spent on developing the multi-passage kiln?

Mr. Walker: Because there is no difficulty in the same operator operating an increased number of passages and operating two and possibly three kilns. The work flows in one direction only, so that in loading and unloading there is no complication. There is a smooth flow.

Mr. Davis: I extend an invitation to members to visit Longport gasworks to see a multi-passage kiln. Next week it will be in use firing ware of some description.

Mr. S. Johnson: Has any work been done in converting gas into radiant heat? Anything being done to develop a radiant heat burner using town gas?

Mr. Davis: There is a radiant cup type of burner.

Mr. W. Whitehead: At what pressure does the town gas crack?

Mr. Davis: Town gas will normally crack at 500°C. About 7.5 volumes of air will prevent town gas cracking up to 12,000°C.

PLANT FOR THE MANUFACTURE OF INSECTICIDES

The gas burners in both units consist of a series of Bray burner jets; the former has a gas rate of 80 cu.ft. per hour at 16/10 in. w.g. working pressure and the latter 120 cu.ft. per hour.

With these devices, it is possible to attain a working temperature of over 100°C. in about 1½ hours from start up and to maintain distillation and feed at a rate of 12 gal. per hour. The feed rate is measured and controlled by the use of Rotameters.

Fig. 3 shows a general view of the fluoroacetamide plant which is duplicated.

Fig. 4 shows a gas-fired steam boiler used in connection with the heating of other chemical plant.

The North Thames Gas Board collaborated with Dr. M. A. Phillips and Associates of Western Road, Romford, Essex (consulting chemists and chemical engineers) in the design of the heating and control equipment. This firm acted as consultants to Associated Fumigators Ltd.

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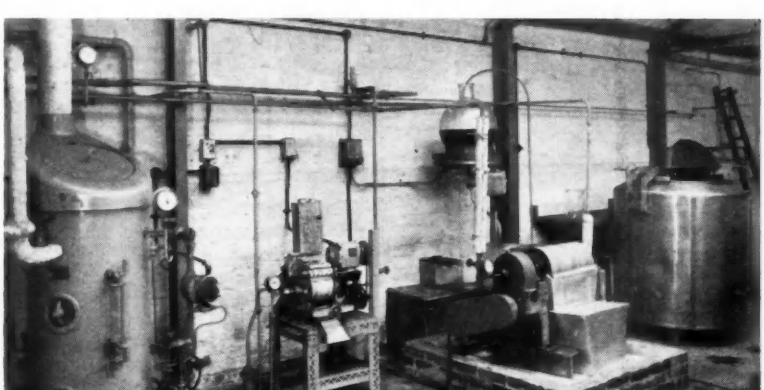


Fig. 4.

How dependent is our way of life on Industrial Gas? A striking illustration of the way in which gas contributes towards the comfort and convenience of everyman is given in this paper by S. HEYWOOD, Assoc.M.Inst.Gas E., A.M.I.Mech.E., Industrial Engineer (Preston Area), West Lancashire Group, North Western Gas Board. It was presented to the Manchester District Junior Association of Gas Engineers under the title

THIS IS OUR LIFE

WHAT is industrial gas? It does not consist solely of gas consumed by tremendously complicated appliances with high gas rates, but also numerous varied applications, large and small. To illustrate the variety of applications I propose to examine one day in anyone's life and to show how the use of industrial gas plays such an important part in that day.

For the majority of us the day starts with the alarm clock—our very first contact with the results of an industrial gas application. A number of operations in the manufacture of parts and cases used in the assembly of clocks and watches are carried out by gas heat. Although in general none of the operations, such as metal melting, spring manufacture, preparation of watch glasses, and stove enamelling of cases, etc., have large individual gas consumptions, they nevertheless form quite an important and consistent gas load. Together with the kindred trades of jewellery, precision instruments and metal goods not specified under any other heading, this forms the largest individual trade gas consumption in the North West, larger than engineering and shipbuilding.

Electric Lamps

The next operation is usually to switch on the electric light. Here again industrial gas is used in many operations in the manufacture of electric lamps, both filament and fluorescent, and of electric fittings. Electric lamp manufacture is carried out extensively in the Preston area, resulting in a consumption of approximately 135,000 therms per year. One of the many processes utilising gas heating is the manufacture of the wire used to produce filaments. This wire, which is continually passing through gas heated equipment, is drawn to exceedingly fine limits. To manufacture the wire a special powder is pressed into bars approximately 18 in. long × $\frac{3}{8}$ in. square which are fired in a hydrogen atmosphere inside a gas-fired furnace having a working temperature of 1,200°C. The now solid bar is processed and passed through varying types of rod and wire drawing machines; during the whole time the bar, becoming rod, and then wire, is heated by high pressure gas burners until the extremely fine filament wire is produced. The glass envelopes are supplied direct from the glass manufacturers, and while they may not necessarily have been manufactured from a gas-heated glass tank, they will have passed through a gas-heated lehr. The envelopes are washed and dried by means of a steam-heated washing machine, the steam being supplied from a gas-fired steam boiler. The manufacture of the complete filaments, cutting and sealing of the glass envelopes, capping, soldering of the terminals, and the many other operations necessary for the manufacture of electric lamps are carried out by high pressure gas-heated machines together with high pressure oxygen and air. In the manufacture of fluorescent lamps, gas-heated continuous ovens are used to bake the fluorescent powder inside the glass tubes. The burners are of the overhead radiant heater type and have been used in preference to electric heaters because of the uniformity of heating, flexibility of control, and—most important—freedom from failure.

The importance to us of the electrical industries of which the manufacture of electric lamps is only one of the many varied instances using industrial applications of gas, is demonstrated by the fact that approximately 10% of the total sales of industrial gas in the North Western area is utilised in the manufacture of electrical equipment. Throughout the whole of the country the percentage is even higher.

We now leave our warm beds and don dressing gown and slippers. The manufacture of leather type goods, including slippers, involves a multiplicity of operations, nearly all of which require some form of heat. In many cases the heat is required in a confined space or has to be concentrated in a very small area. For these and other reasons gas is almost universally used as the heating agent in such operations as bottom filling, bobbin winding, pricking up, sole embossing, patent leather warming, edge setting, seam rolling, etc. The slippers, shoes, clothing and other textile articles we use are responsible for 3% of our total sales of gas to industry.

Pausing during our hurried toilet to reflect upon the part played by industrial gas in the manufacture of the preparations we use, we take our place for the morning meal. The good morning smile with which we greet the family often displays another product of industrial gas—dentures. It is a recognised fact that artificial teeth manufactured in this country are equal to the finest in the world. The importance of this industry to ours is clearly shown when we consider the fantastic output of two such firms in this group. One firm alone 'reputed to be the largest in this country' produces tens of millions of artificial teeth per year, exporting them to many countries including America. We can safely say, therefore, that a large proportion of the good morning smiles all over the world owe their brilliance in no small way to British industrial gas.

Newspaper Printing

The morning paper behind which we hide our faces has arrived, having been produced with the aid of gas. In the production of any printed matter, even income tax forms, gas plays its part. The autoplate machines used by newspaper printing offices, from which the curved plates are cast, hold anything up to 7 tons of metal. Gas has now very largely taken the place of other fuels for the heating of this metal, because among other advantages the accurate temperature control obtained by gas heating reduces the number of faulty plates. This is an important point in the newspaper industry where every minute is vital. The paper and printing industry consume approximately 1% of the total sales of gas to industry in the North West.

The breakfast we consume is cooked by gas, but prior to the actual cooking many of the ingredients forming the meal have been prepared by gas-heated equipment. Bread will almost certainly have been baked by gas in ovens of the conveyor type, reel type (which are becoming more and more

popular), or batch type ovens. One of the ingredients of bread is gluten, which is a most difficult substance to dry and prepare. Many varied experiments have been carried out by a firm in this group, and together with some assistance from the Industrial Section in the North West, this firm is now successfully drying and grinding gluten. The plant is principally a hot air application and four smaller plants each consuming approximately eight therms per hour are now in operation, while two larger plants each capable of consuming approximately 27 therms per hour are in the course of erection. Allowing for the fluctuation of demand, since gluten is now used for many purposes, this firm will consume approximately 60,000 therms of gas per year, all of which has grown from a very small beginning.

Gas in the Food Trade

The utilisation of gas in the food trades is so varied that it is possible to mention only a few examples, such as cooked meats, sweet and chocolate confection, breakfast cereals, and fruit ripening, particularly bananas. We have in this group a number of banana ripening rooms. The bananas are brought to the local docks in an unripened condition, and the final ripening ready for consumption is carried out by means of gas-heated, thermostatically controlled ripening rooms. By varying the temperature control, to which gas lends itself so readily, the bananas can be ripened either quickly or slowly to meet the demands of the fruit market. The gas installation is very simple and consists only of industrial jets, room thermostat and relay valve, and suitable wire guards, and yet it performs a vital service. The warehouse in which the unloading and packing is carried out has also to be kept at a uniform temperature, and this has been achieved by the installation of overhead radiant heaters. The gas consumption for this installation is approximately 7,000 therms per annum. There are, of course, many other uses of gas in the food trades, such as steam raising and water heating, etc.

The china, earthenware, and glass containers which we have used in conjunction with our morning meal have been produced with the use of industrial gas. The use of gas for the firing of ceramic kilns is not a new idea. I have been told that the Chinese used gas produced from wood to fire their kilns, and the wonderful glazes they produced were partly the result of an industrial application of gas. My own experience of kiln firing shows that gas has many advantages over other fuels, particularly in the uniformity of heating and ease and accuracy of control, resulting in fewer rejects, reduction of floor space and, in a lesser degree, speed of operation, although this point is one which is determined by the articles being fired. China and earthenware are responsible for approximately 2½% of our total gas sales to industry in the North Western area, while the glass and glass container industry plays a very important part. In the South Lancashire Group there is a glass works whose name is a household word whenever the word glass is mentioned, and this firm, together with the smaller glassworks and factories, consume approximately 11% of our total industrial sales of gas, manufacturing such articles as shop and house window glass, ovenware and tableware, bottles, drinking glasses, etc.

The means of transport to our place of employment, whether by public transport or a private vehicle has, during its manufacture, been the subject of various applications of industrial gas. The vehicle industry in the North Western area is responsible for the consumption of approximately 4½% of our total industrial sales.

All industrial gas applications are not of this size. When I was a member of the Liverpool Industrial Department I was quite excited at the development of a typewriter burner. The burner was a very small bunsen burner with a pencil shaped flame with a consumption of about 1 cu. ft. per hour. The reason for the excitement was because until then the repair of typewriters was accepted as a job only possible by means of an electrically-heated soldering iron of very small dimensions.

Furniture Manufacture

Arriving at our place of employment our working day commences. The office furniture and fittings have, during their manufacture, benefited by industrial gas applications—stove enamelling of metal furniture, manufacture of varnish and paint, etc. In this area one firm manufacturing paints and varnishes consumes 90,000 therms per year.

The plastic articles we use in our places of work and homes have developed with enormous rapidity, and in their manufacture or moulding the temperature control is of major importance. Various plastics have widely different bases, and in the majority of cases town gas offers decided advantages over other methods of heating. Steam heating of moulds is also quite common, but here again gas-fired steam boilers with their rapid and constant evaporation can provide the steam requirements.

Entering our workshops we realise that in addition to the direct application of gas used in the actual premises, gas has played its part in the manufacture of the benches, racks, bins and instruments.

The cigarette or pipeful of tobacco, or even that pinch of snuff, many of us will enjoy during the day, is still another example of the end product of an industrial gas application. Gas plays a useful part in the drying of the tobacco in rotary kilns, and in the manufacture of the packets and cartons in which the products are marketed. In fact, together with the food trades previously mentioned and the drinks which we may partake during some part of the day, they account for approximately 12% of the total industrial gas sales in the North West. This is the third highest industrial gas consumption in the North West and well above the average for Great Britain.

Radio and Television

The evening arrives, and after retracing our morning journey many of us spend a portion of our time listening to the radio or looking at the television. These two sources of entertainment have utilised applications of gas varying from component, tube and valve manufacture to that of the cabinet. Even if we leave our homes and go to the theatre, industrial gas is still with us. I remember when there was a swimming display at our local theatre and the chorus girls staged a lightning strike because they considered that the water in the tank was too cold. In a panic the producer asked us to fit some burners to heat the water. Happily this was accomplished without delay, and once again the tradition of theatre was upheld and the show went on.

The end of the day is in sight and as we retire to bed we still have reason to be thankful to industrial gas, for the textile industry uses gas in many processes, such as gassing, singeing, conditioning and calendering, etc., and the springs in the mattress, the feathers or other material in the pillows have also been subjected to gas heat treatment.

It is said in our industry that there are 1,001 uses for gas. And I think you will agree that there never was a truer saying because, apart from the other uses of gas for domestic and commercial applications, there are 1,001 uses for it in industry. If we just visualise the instances I have quoted and the very many other instances which spring to our minds, it is very easy to assess the major importance that the application of industrial gas has played in our day.

Dublin Exhibits Gas at Work in Industry

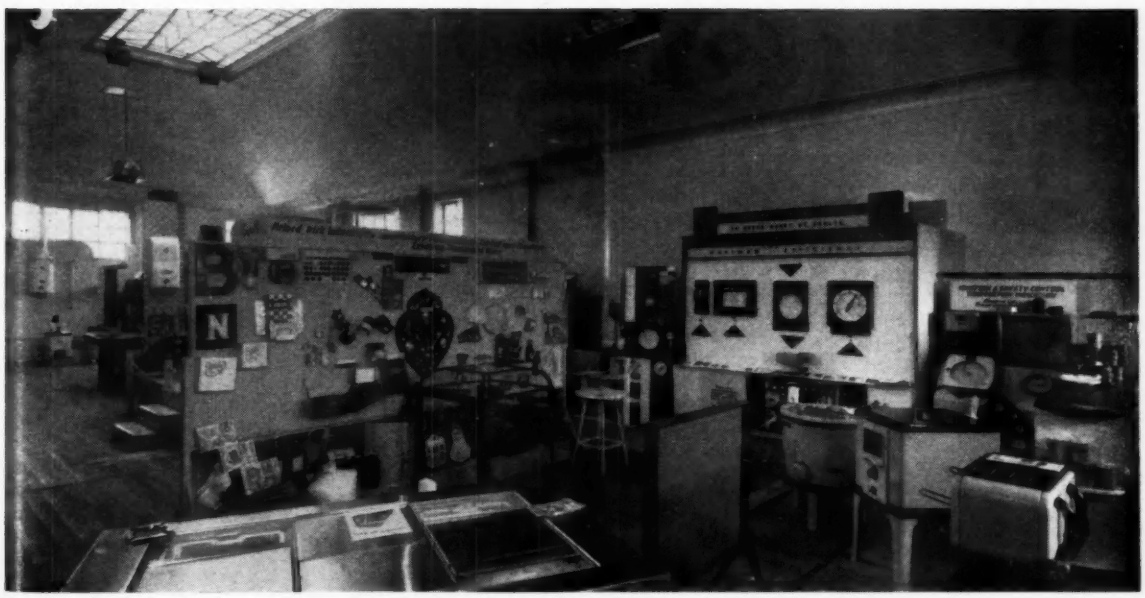
AN exhibition to show industrialists in the Irish Republic how gas can aid them in their business was staged by the Alliance and Dublin Consumers Gas Company in the capital recently. The accent was also on the commercial uses of gas and even the domestic side, as the picture at top right shows, was not overlooked.

On the industrial side, the heat treatment of metals, flame processing, and foundry processes using gas were exhibited. Metal melting was also demonstrated, and there was a comprehensive display of industrial gas burners and automatic control gear.

Drying ovens, industrial liquid heating equipment, and steam raising plant also featured in the show, as did space and water heating appliances for all applications. Commercial catering equipment was well represented and in this and the domestic field, there was a full-scale model of SEDuct.

Manufactures of the Irish Republic in which gas is already used—as was illustrated in a special section of the exhibition—include cigarettes, glassware, shoes, colour-printing, women's hats and pleated skirts, and confectionery. Causing a little surprise, a bunch of bananas was seen among these manufactured goods—gas, of course, having been used in the ripening process after the importation of the fruit into Ireland.

The Exhibition was well timed since the Company's industrial gas tariff had first been revised and improved, and the lower rates were about to be put into operation with the domestic reduction, which, as reported in the 'GAS JOURNAL,' took effect last month.



Factory Equipment and Thermal Insulation

Largest Variety Ever Seen Under One Exhibition Roof

THE 6th Factory Equipment, Heating, Ventilation and Thermal Insulation Exhibition was held at Earl's Court, London, last month. Organised for those concerned with the management, production, construction, maintenance, efficiency, and welfare of every type of factory, it contained the largest variety of factory equipment and plant ever assembled under one exhibition roof.

The tremendous advances which have taken place in recent years in methods of storage and partitioning were brought home by the display of some of the latest and most efficient equipment now available.

Exhibits in the materials handling section included a wide variety of conveyors, fork-lift and other trucks, stackers, stillages and pallets for every type of load.

Air conditioning and dust extraction plant, fume-exhaust units, and fan-ventilating systems, suitable for all types of industry were shown and more than 50 stands were devoted to overalls, heat and chemical-resisting suits, fire protection and alarms, machine guards, safety walks, industrial heating, canteen equipment, etc.

A variety of packing equipment, material and methods was displayed, while works benches, hand and power tools, hydraulic and pneumatic equipment, compressor units, lubrication systems, welding equipment, punching, shearing, tube bending machines, valves, jacks, pumps, etc., had a good showing.

Of particular interest was the display of mechanical screens and strainers, vibratory sorters and feeders and batch counters; while the latest spray guns and spraying equipment were demonstrated under working conditions.

For records and other paper work involved in factory operation, a great variety of busines systems and production-control equipment was exhibited. These included calculating machines, duplicators, photocopying equipment, coding and dating equipment, and similar products, together with the latest systems for dealing with P.A.Y.E. and stock control. Intercommunication equipment, clocks, time recorders, fire and burglar alarms, locks, staff location systems and public address systems were also exhibited.

Among exhibitors well known to the gas industry were **Allied Ironfounders, Ltd.,** although on this occasion they had placed the accent on oil-fired equipment. Their 'Spacewarmer and 'Airborne' 'Rayburn' oil-fired units were on show.

G. F. E. Bartlett & Son Ltd. showed all types of cooking and food service equipment for factory canteens and tea service installations. A typical cafeteria service counter was displayed including hot, cold and beverage service sections.

Also seen were hot cupboards, fish fryers, steaming oven, boiling pan and sink units, together with automatic tea- and coffee-making appliances, café sets, coffee machines, tea and food service trolleys, insulated food and beverage containers, and water-boiling equipment.

The British Vacuum Cleaner & Engineering Co. Ltd., and the Magneta Time Co. Ltd., were showing their large range of portable industrial cleaners, and illustrated pneumatic flue-cleaning which removes hot ash while the boilers are under steam. Also seen were B.V.C. machines for extraction, reclamation, or removal of dust, light materials or even liquids, and a wide range of tools covering most cleaning problems.

The Magneta Time Company showed a wide range of electrical timing apparatus, and their sound equipment, which includes loud-speakers and high fidelity audio power ampliflers having provision for microphone, together with gramophone pickup input channels.

Thomas De La Rue & Co. Ltd., Potterton Division, exhibited a selection from the wide range of Potterton oil-fired boilers, suitable for the provision of central heating and hot-water supply in industry. A new Potterton training film showing the ease with which a Potterton oil-fired boiler can be erected, was seen on the stand.

Fibreglass Ltd., had full-scale exhibits showing typical ways in which fibreglass is used to insulate roofs to a high standard at low cost. They included insulated sandwich roof systems, Fibreglass ceiling board; and a roof lining system combining effective noise reduction with high thermal efficiency.

Fibreglass rigid sections for piping insulation formed the other main feature on this stand.

J. Glover & Sons Ltd., showed 'Ingold - Compactus' space - saving storage equipment which increases storage capacity by 90% and 150% over the same floor area. Electrically operated, this system eliminates gangways and is specially suitable for racks, bins and pallets in engineers' stores.

Harris Engineering Co. Ltd., showed the well-known range of Harris industrial space-heating equipment, including 'Schwank' gas infra-red radiant heaters for wall mounting or horizontal suspension, gas unit heaters (flued and un-flued). The 'Wellsway' Mark 2 flued gas convector heater, and an oil-fired air heater, which can be used free standing or conected to duct work. A similar model is available for horizontal suspension.

The Harris range of air-cleaning equipment, also illustrated, included dust collectors and 'Trion' electronic air filters which have an efficiency of 99.9% (weight test).

G. A. Harvey & Co. (London) Ltd. showed a wide range of new adjustable steel shelving with its extreme flexibility and adaptability to individual requirements. All components are interchangeable enabling any alterations or extensions to be carried out as desired.

Harvey steel office furniture, clothes lockers, stillages, machinery guards, perforated metals and plastics in a wide range of patterns, woven wire cloth and wirework screens, were some of the items which served to indicate the varied range of Harvey and 'Harco' products.

The Kleen-E-Ze Brush Company Ltd. showed all classes of industrial brushware, mops, and floor dressings, including the 'K.A.M.' unit for conveyor-belt cleaning, completely assembled for instant adjustment and motorised ready for installation. Brush rollers made from nylon metal-backed 'Kez-strips,' which are easily replaced, were also seen, and 'Kez-Strip' metal-backed strip brushes.

'Keza' bullets for condenser tube cleaning, 'Brush-Welt' draught excluder (as standard for British Railways) and 'Florigene' fluid dust-allayer, were on show, too, as well as wax polish for floors and furniture.

J. C. Neville Ltd., showed their 'RG' tube-cutting and screwing machine. The thread production is by means of the milling hob principle, and only two hobs are required for BSP threads. The circular slitting saw is mounted on the cutting spindle and assures a clean, burr-free cut. Accessories for the production of American, Conduit, Whitworth or Unified screw threads are available.

Continued on p. 28

The Holmes-Maxted Process in Industry

The nuisance value of organic sulphur compounds present in towns gas to the ordinary consumer are well known. In certain industrial processes their presence can be both costly, and harmful. This article gives a brief outline of the Holmes-Maxted catalytic sulphur removal process and descriptions of plants installed in the works of consumers requiring a low sulphur gas, the plants having capacities from 250 to 30,000 cu.ft. per hour. Operational results from selected plants at work in the glass, vitreous enamelling, ferrous and non-ferrous metallurgical industries over the past 15 years are given.

By JAMES J. PRIESTLEY,

M.Sc., M.I.Chem.E., M.Inst.Gas E.

(W. C. Holmes & Co., Ltd.)

THE increase in the use of town gas for industrial purposes has been one of the major contributory factors in the continued expansion of the gas industry. It is a well known fact that at the present time more than 50% of the output of some undertakings is to industrial concerns, and that the proportion for the great majority of works is substantial. Not only has the amount of gas sold to industry as a whole increased, but the field of application has been widened considerably to include a great diversity of heat treatment processes. The advantages of a ready made fuel of constant composition and quality, and flexible in its applications, have been recognised and in spite of the rise in price, gas is still able to secure fresh markets in this field.

Although town gas as supplied is sufficiently pure for most industrial processes, the organic sulphur content is undesirable and even harmful in some cases. The removal of organic sulphur at gasworks has been practised only to a limited degree and this by the use of the oil washing and active carbon processes. With the chronic shortage and high price of gas-making coals, the economics of benzole recovery by oil washing have taken a less favourable turn, with the result that the majority of benzole plants in this country are at present shut down or at the best are operating only for the removal of naphthalene. This has in turn reacted unfavourably on the organic sulphur content of the distributed gas and put the industry at a disadvantage in the field of demand where a low sulphur fuel is required.

It is not difficult to remove the organic sulphur content of town gas to such a degree that in this respect it is competitive with electricity. With regard to the competition from oil, gas may be at a disadvantage with respect to price, but by desulphurisation can be put in a favourable position for the production of a low sulphur atmosphere. The sulphur content of many fuel oils can be high and the source of supply must be selected with care if sulphur oxides are known to be deleterious to the process.

The fact that it is not difficult or expensive to remove organic sulphur compounds from gas has been fully demonstrated by several industrial firms requiring a low-sulphur fuel for their processes. In these cases they have installed their own organic sulphur removal plants to treat the gas prior to combustion, thereby introducing a refinement of purification which should logically be carried out at the gasworks.

Outline of the Process

The development of the Holmes-Maxted process and operating results on a full scale gasworks installation at Mirfield, Yorkshire, have been described elsewhere[1, 2, 3, 4]. This paper will be concerned with the industrial application of the process in the works of the specialised consumer. Briefly, the Holmes-Maxted process is one in which the organic sulphur compounds are destroyed by hydrogenation, with the production of hydrogen sulphide as an end product, for example,

$$CS_2 + 2H_2 \rightarrow 2H_2S + C.$$

Raw gas is first subjected to a process of heat exchange (see Fig. 1) followed by a final heating to a temperature of about 300°C. It is then passed into a bed of catalyst where the temperature rises further to about 365°C. It is here that some of the hydrogen normally present in the gas reacts with the organic sulphur compounds, generally as shown in the above equation. The gas leaves the catalyst bed to pass through the heat exchanger to a stage of final cooling where it is cooled to atmospheric temperatures. It is then passed through an iron oxide purifier in which the hydrogen sulphide is removed and thence to the process for which the gas is required. The process is normally operated at atmospheric pressure or at 1 or 2 lb. per sq. in. There is no disadvantage at operating at much higher pressures, for instance up to 200 p.s.i.g.

Not all the organic sulphur is removed by this treatment. The degree of reduction is governed largely by the proportion of the individual sulphur compounds present in the raw gas. Carbon disulphide and carbon oxysulphide are easily hydrogenated, but thiophene is only slightly attacked. It is for this reason that better results are obtained with vertical retort gas, where the thiophene is low, than coke oven or horizontal retort gas where the thiophene is high. Removal efficiencies vary from 70 to 90% depending on the sulphur compounds present.

Extremely satisfactory results may be obtained with a de-benzolised gas, because the processes of benzole recovery, either by the use of active carbon adsorption or oil washing, are complementary to the catalytic process. During benzole recovery, thiophene is removed along with the benzene; carbon disulphide is removed to

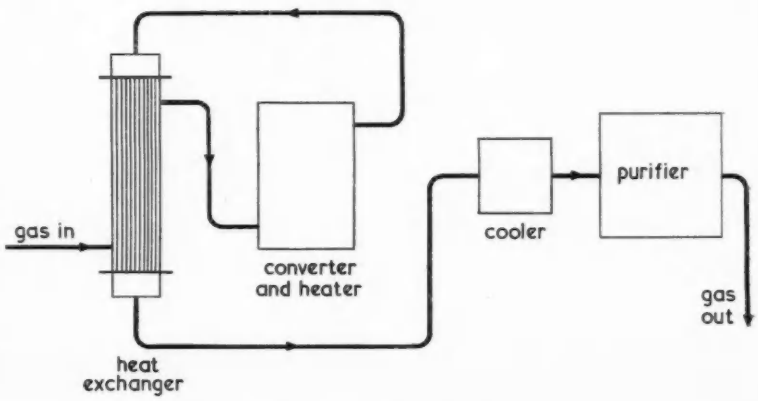


Fig. 1. Flow diagram of Holmes-Maxted Process.

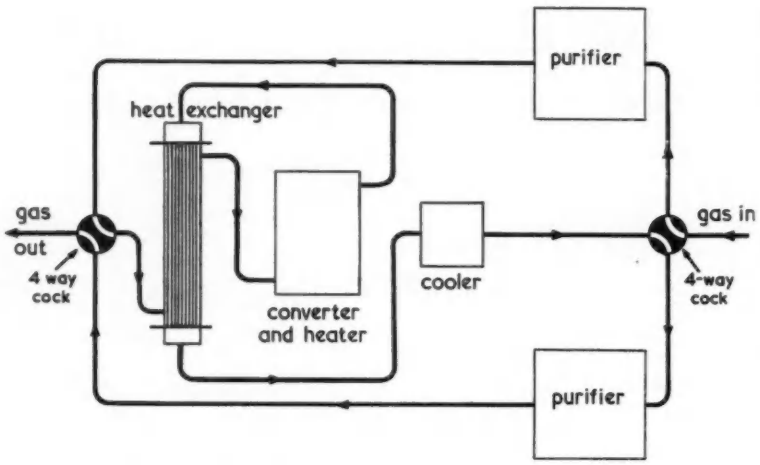


Fig. 2. Flow diagram showing double purifier system.

a variable degree, and carbon oxysulphide left almost unchanged in the gas. In other words the substance most difficult to hydrogenate, *i.e.*, thiophene is removed easily in the benzole recovery process. The substance which cannot be adsorbed or absorbed there, carbon oxysulphide, is easily dealt with in the catalytic process.

Plant Design

The design of plants for industrial use allows for considerable simplification when compared with that of plants for gasworks.

(a) Plants are of smaller size and usually work at a definite throughput or are shut down. The load variations which normally occur on gasworks are absent.

(b) The oxygen content of the gas is usually much more steady than that of make gas. Variations in oxygen content cause variations in the temperature of the catalyst bed because the catalyst, in addition to promoting the hydrogenation of sulphur compounds, promotes the highly exothermic reaction:

$$2H_2 + O_2 \rightarrow 2H_2O$$

The variations in catalyst temperature are not in themselves important, but it is desirable to keep the preheater working at a reasonably constant rate, with as little fuel gas as possible.

(c) On very small plants (less than 1,000 cu.ft. per hour) heat exchangers may be omitted entirely.

It has been possible to standardise designs of plants up to capacities of 6,000 cu.ft. of gas per hour. With larger sizes of plant, designs have been changed in the normal course of development. One of the most important features of the industrial plant development was the double purifier system[4] which operates as follows: Gas leaving a catalyst bed or 'converter' contains no oxygen (or possibly only a slight trace due to mechanical slip) and consequently none reaches the oxide purifier. After about one week's operation this will begin to slip hydrogen sulphide, as no oxidation ('revivification *in situ*') has taken place. In the double purifier system (Fig. 2) this defect is overcome. Two purifiers are used, one being on the incoming gas stream, the other following the cooler on the converter outlet. When the working purifier begins to slip hydrogen sulphide, the position of the two purifiers is interchanged, so that a fresh one takes over the removal of hydrogen sulphide, while the spent one is 'revivified' by the oxygen present in the untreated gas stream. Remarkable results have been obtained with this system, to illustrate which, the following may be quoted: 'The bog ore has a very long life when this system (*i.e.*, double purifier) is used. 45 mill. cu.ft. of gas have been treated by approximately 25 cwt. of bog ore, untouched for seven years with perfectly satisfactory results[5].'

The purifiers in question were handling gas containing about 15-18 grains per 100 cu.ft. of hydrogen sulphide, and the boxes were 'changed' or reversed once per week.

On small plants (less than 1,000 cu.ft. per hour) shell and tube heat exchangers are omitted entirely, the converter and air cooler for treated gas standing on top of the double purifier unit (Fig. 3). On the range 1,000-6,000 cu.ft. per hour, a shell and tube

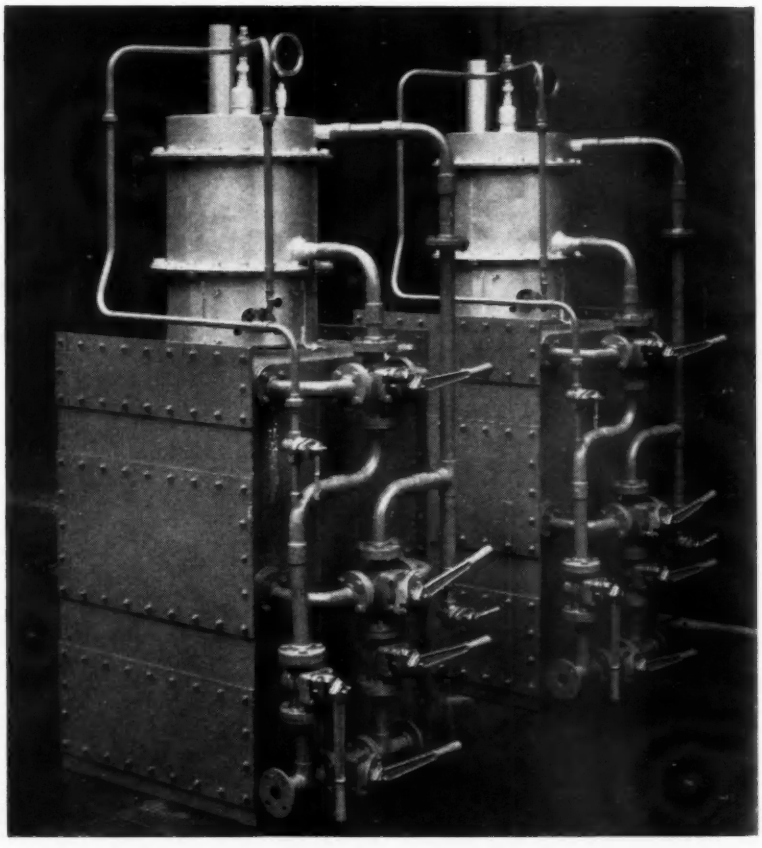


Fig. 3. Two 250 cu.ft. per hour plants awaiting delivery.

heat exchanger surmounts the catalyst bed, the final heating being done by neat gas flames beneath the catalyst chamber itself. The purifiers and cooler are built separately (Figs. 4 and 5). Fig. 6 shows the largest industrial unit in operation, having a capacity of 30,000 cu.ft. of gas per hour in which the heat exchanger and the catalyst converter have been made as separate units. In some cases a fan booster is used to propel the gas through the plant and give extra (and usually welcome) pressure at the process burners. In others ordinary service pressure is sufficient. Final gas cooling after heat exchange is carried out in cast iron radiator elements working in parallel with provision for air cooling by fan in hot locations or in hot weather. The following table gives approximately the space occupied by various sizes of unit.

Space Requirements of Holmes-Maxted C.S.R. Plants.

Rated Capacity cu.ft. gas per hour.	Area Occupied by Plant.	Height (Including Headroom).
250	3 ft. × 3 ft.	8 ft. 6 in.
1,000	7 ft. × 3 ft. 8 in.	9 ft. 6 in.
2,000	11 ft. × 11 ft.	14 ft.
4,000	11 ft. × 11 ft.	14 ft.
6,000	11 ft. × 11 ft.	14 ft.
8,000	16 ft. × 20 ft.	16 ft.
30,000	30 ft. × 60 ft.	21 ft.

Operation of the plants is automatic requiring only a few minutes attention per day. On the smaller sizes, the catalyst charge is replaced as a whole when it has become spent, usually every 3-6 months. On the larger plants, catalyst is passed through the plant semi-continuously by discharging about 0.4 cu.ft. of catalyst each day and replacing it by the same amount of regenerated material. Catalyst regeneration may be carried out by clients themselves or returned to Messrs. W. C. Holmes for treatment.

Industrial Applications

The small industrial units were developed and installed before the full scale gasworks plant at Mirfield[3], which, in fact, was the eighth plant to be installed. Below is a table giving details of installations to date.

Holmes-Maxted C.S.R. Plants in Industry.

Type of Industry	1st Instal. date	No. of plants Installed	Max. size of plant installed cu. ft. per hr.
Glass	1942	20	4,000
Vitreous enamelling	1950	2	250
Engineering (pre-treatment for gas carburising) ...	1947	21	500
Metallurgical nickel processing	1943	2	30,000
Others ...	—	4	8,000

In addition to the United Kingdom, plants have been installed in New South Wales, Holland, Ireland and Spain. The majority of these plants are still in operation although some have been shut down due to changes in process or technique.

(a) *The Glass Industry*

One of the principal causes of complaint from glassworks, in which articles for the domestic and scientific markets are made, is that in all processes in which the ware comes into contact with open flames or their products of combustion, the presence of sulphur as sulphur dioxide causes the formation of a film on the surface of the glass, which is known as 'bloom.' This takes the form of a white mistiness and is due to the formation of sulphates between the constituents of the glass and the oxygen and sulphur dioxide in the furnace atmosphere. It is preferable to maintain oxidising conditions of this type otherwise a different type of film is formed under reducing conditions which with lead crystal glass is a black stain of metallic lead. Bloom, on the other hand, can occur with both lead and soda glass due to the formation of the respective sulphates. Sodium sulphate may be removed by water washing, but lead sulphate can only be removed by washing the articles with hydrofluoric acid which actually removes a thin surface layer of glass.

The presence of surface films of bloom has an additional disadvantage other than unsightliness. They prevent the proper adhesion of parts which are put on to the main article, such as the handles of jugs, feet of bowls, etc., which frequently leave the article, either immediately after annealing or even some time later after the article has been stored or sold, without leaving a mark.

The actual manufacturing operations which can cause blooming when a high-sulphur gas is used have been described in detail by Tomes[6] and are as follows:

(a) Reheating of ware during shaping in 'glory hole' furnaces which are small cylindrical shaped furnaces about 1 ft. diameter by 1 ft. 9 in. long.

(b) Annealing, unless the annealing lehr is of the muffle type. These are up to 70 ft. long.

(c) 'Cracking off' and edge fusion of ware, such as tumblers. Part-made tumblers have a diamond scratch drawn across the body at the desired height, and then small intense flames are impinged on the scratch to crack off the unwanted top portion. Next the ragged edge

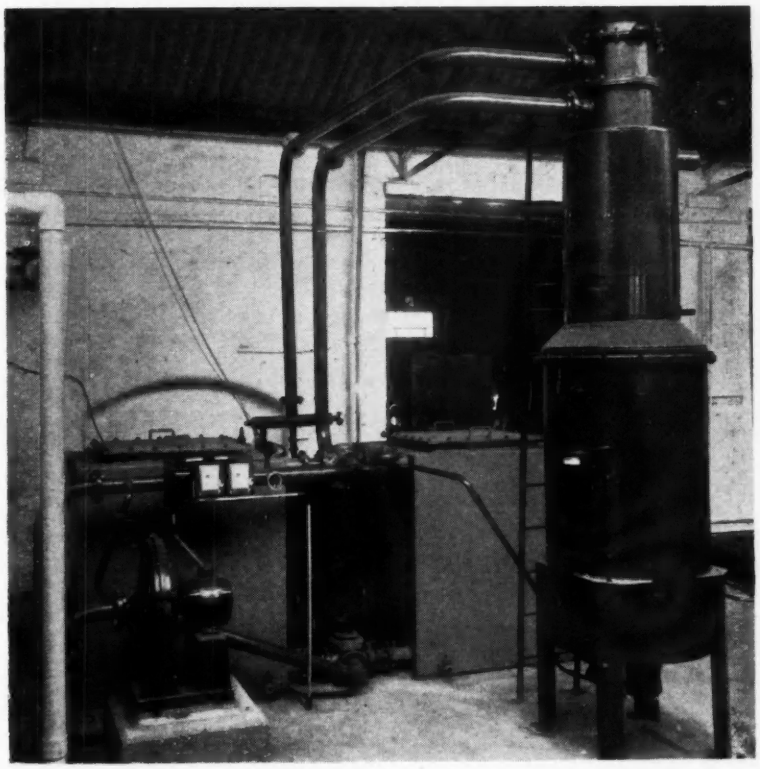


Fig. 4. A 4,000 cu.ft. per hour plant installed at a Stourbridge Glassworks.

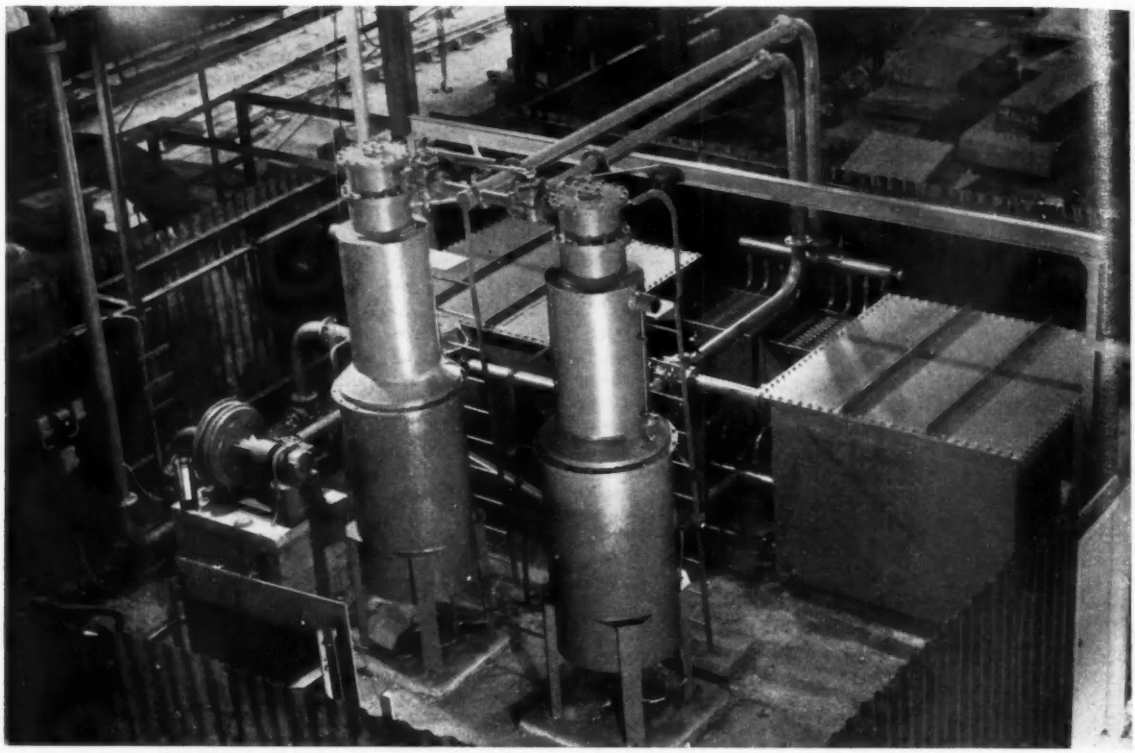


Fig. 5. An 8,000 cu.ft. per hour plant installed at Colvilles Ltd., Glasgow. Two 4,000 cu.ft. per hour converter units are installed to work in parallel. Behind are the two purifiers with the gas cooling unit between them.

is smoothed by a partial meeting of the edge in the flames of burners of the Bournkessel type to leave a smooth rim. Sometimes the edge is 'stoned' or ground smooth prior to edge fusion.

A further point arises in respect to annealing. Open type lehrs, in which the flue gases make contact with the ware use considerably less fuel gas than the muffle type, but unless desulphurised gas is used this advantage is offset by blooming troubles.

Most of the Holmes-Maxted plants installed in the glass industry are operating in factories producing table ware of all types. Typical of these plants is the installation at the Dennis glassworks of Thos. Webb & Sons Ltd., Stourbridge, who supplied the following data[3].

Products: Lead crystal tableware and scientific glassware in borosilicate.

Operations using desulphurised gas:

(a) Reheating in glory hole furnaces.

(b) Edge fusion after annealing.

(c) Melting of lead crystal glass in small day tank furnaces.

Catalyst plant installed: 1944.

Rated capacity: 4,000 cu.ft. per hour.

Average rate of gas during use: 2,000-3,000 cu.ft. per hour.

Period of use: 16 hours a day, five days a week.

Type of gas c.v.r. and c.w.g.

Whether debenzolised: Yes.

Inlet organic sulphur content (av): 25 grains per 100 cu.ft.

Outlet organic sulphur content (av.): 3-4 grains per 100 cu.ft.

Maximum permissible organic sulphur: 4-5 grains per 100 cu.ft.

Vol. gas treated per charge of catalyst: 3 mill. cu.ft. (varies).

Process cost: Extremely low; maintenance consists of annual clean-out.

Unexplained Deposit

It will be remembered that it was on this plant that the remarkable performance of the oxide purifiers was obtained, to which reference has already been made. Also this plant is one of the two in which an unexplained deposit has been collected from the gas outlet side of the shell and tube heat exchanger. On analysis this was found to consist of 11% polymerised gummy bodies and 89% ammonium chloride. It is known that gas leaving a catalytic sulphur removal plant is free from gum forming bodies, and in this case were largely deposited in the heat exchanger. The ammonia can be explained but not the source of chlorine, unless it is a chlorinated hydrocarbon present in traces in the gas itself.

(b) *Vitreous Enamelling*

Articles such as components of cookers, which have a vitreous enamel finish, are subjected to two processes of heat treatment after the initial application of the 'frit.' First the parts are dried, after which they are fired at a temperature sufficient to fuse the enamel to a smooth continuous sheet over the whole surface area. A high gloss finish is the criterion aimed for, this property being measured by a 'gloss meter.' The effect of the pick-up of sulphur oxides is to diminish the glossiness of the enamelled parts, known in the trade as 'scumming' and is due to the formation of a dull gray film of sulphides which appears some days after firing.

The scumming effect of sulphur oxides is cumulative, the more sulphur oxides that are picked up, the worse the scumming becomes. The ideal fuel for both drying and firing would be one that is sulphur-free but as this is difficult to attain, a fuel as low as possible should be sought.

Drying of components is usually carried out by the direct convection of flue gases, and firing in muffle furnaces. The catalytic sulphur removal plant installed at one works was considerably over-loaded, hence it was not possible to reduce the organic

sulphur compounds in treated gas to much less than 7 grains per 100 cu.ft. from an inlet figure of 25 grains per 100 cu.ft. This gas was then used in the drier only, firing being carried out in muffles. A long series of experiments established the connection between the degree of scumming and the organic sulphur content of the gas used in the drier.

On the second installation at another works a series of tests was carried out with the object of reducing the fuel consumption in the firing process itself by using an open furnace instead of a muffle of the conventional type. Again the correlation of the scumming and the organic sulphur compounds of the gas burned was noted. These experiments were carried out at a furnace temperature of 760°C. with an organic sulphur content of 4 to 6 grains per 100 cu.ft.

There seems to be no doubt that sulphur oxides picked up during drying, together with those picked up during firing are additive, as far as scumming is concerned. If one is very low, risks can be taken with the other. An ideal system which was planned, but for other reasons not put into practice, would be to desulphurise the furnace gas supply, using a two stage process of catalytic sulphur removal and activated carbon treatment, firing into an open furnace, using the flue gases for drying the components.

(c) *Pretreatment during gas Carburising*

In the gas carburising process, raw town gas is prepared in a catalytic plant and the undesirable constituents, namely carbon dioxide, oxygen and water vapour are removed completely, leaving a gas which is completely satisfactory for gas carburising at a rapid rate at any selected temperature without undue formation of soot.

This process works entirely satisfactorily but only when the organic sulphur content of the town gas used is below 20 grains per 100 cu.ft. At higher values the presence of sulphur compounds tends to retard carburisation and moreover the sulphur attacks the nickel-chromium heat-resisting alloys of which the catalyst vessel and carburising retort are made. The action of sulphurous gases on nickel and nickel alloys can lead to intergranular embrittlement known in the trade as 'cold shorts.' The extent of the attack is most marked in reducing, rather than oxidising, atmospheres probably because of the absence of an oxide film which has some protective value. Embrittlement can be quite pronounced at temperatures as low as 400°C. while sulphur dioxide is most dangerous in the range 700-900°C. In atmospheres containing hydrogen, as in carburising, both sulphur dioxide and organic sulphur compounds are reduced to hydrogen sulphide by the catalytic effect of the nickel itself which is considerably worse than sulphur dioxide, as is shown below[7].

Sulphur Attack of Nickel-Chromium Alloys

Sulphur Gas	Alloy	Increase in weight grams per sq. metre per hour 650°C.	800°C.
Hydrogen Sulphide	50Ni/33Cr/13Fe	56.0	244.0
	80Ni/20Cr	92.0	1182.0
Sulphur Dioxide	50Ni/33Cr/13Fe	3.7	2.0
	80Ni/20Cr	105.0	2.8

The firm of Wild Barfield Electric Furnaces Ltd. were faced with this problem on several of their gas carburising installations. They solved it in each case by installing a small Holmes-Maxted plant to treat the raw town gas before it entered the main gas carburising catalyst plant. The duty called for was easily exceeded as most of the Holmes-Maxted plants reduced the organic sulphur content to about one-fourth (5 grains per 100 cu.ft.) of the maximum toleration. Several combined plants have been installed in the engineering industry, on the specific duty of carburising such components as aero engine parts, super-charger gears, large gears and pinions, gun and armament parts, motor car parts, parts of automatic machines and rock drills.

(d) *Nickel Processing*

Problems associated with the attack of sulphurous gases have already been noted in the previous section. These became acute for Henry Wiggin & Co.,

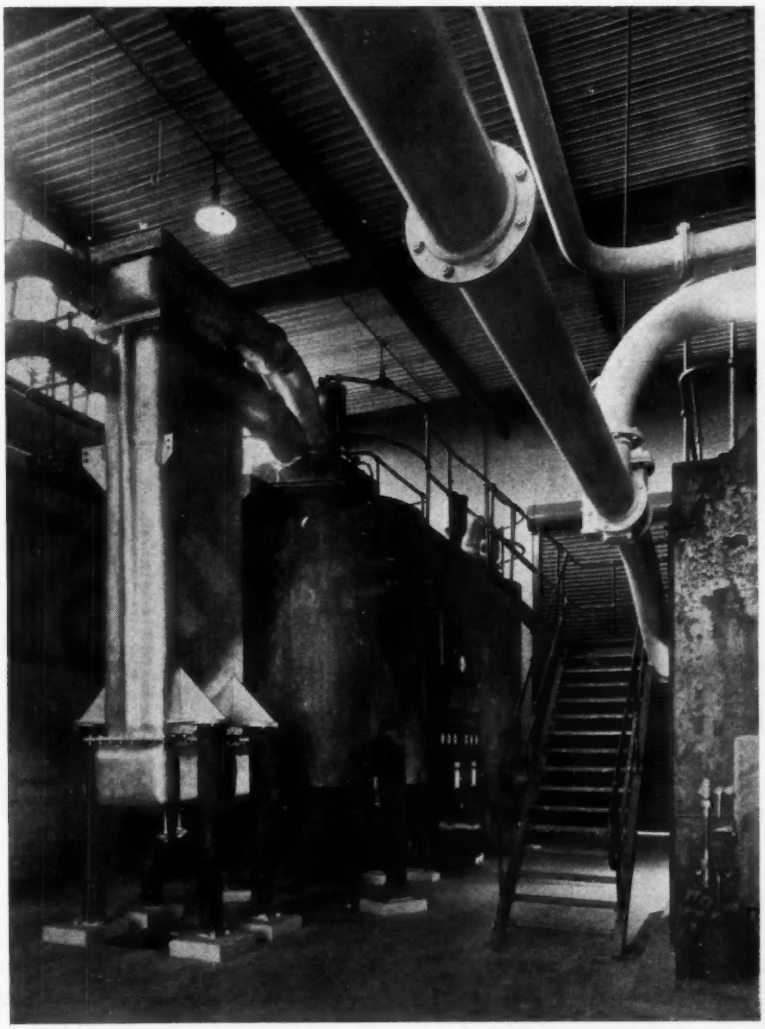
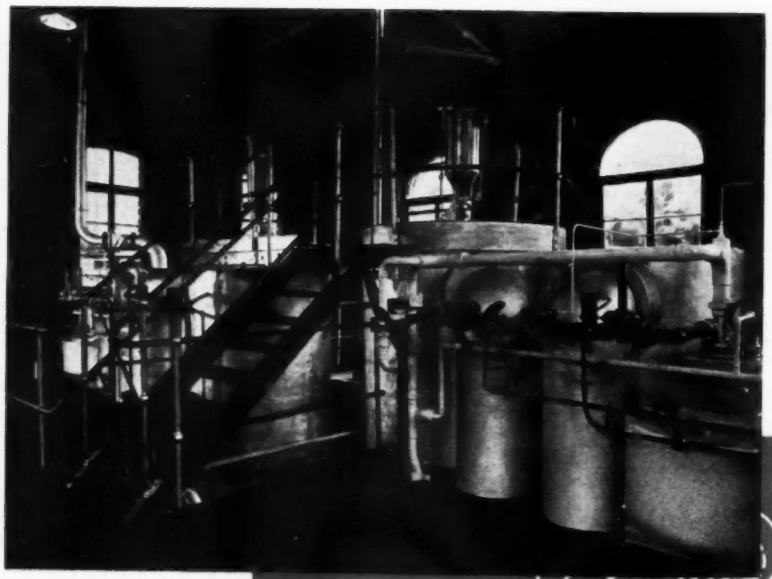
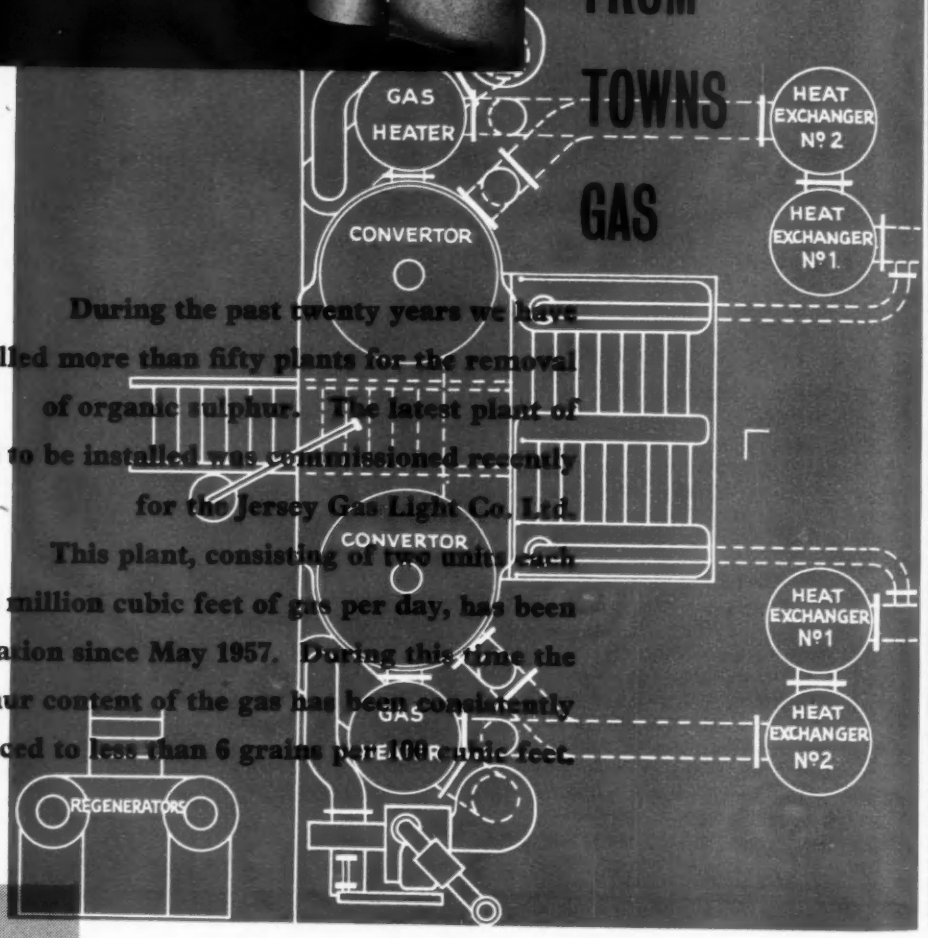


Fig. 6. The 30,000 cu.ft. per hour plant at Henry Wiggin & Co., Ltd., Hereford.



ORGANIC SULPHUR REMOVAL FROM TOWNS GAS



During the past twenty years we have installed more than fifty plants for the removal of organic sulphur. The latest plant of this type to be installed was commissioned recently for the Jersey Gas Light Co. Ltd.

This plant, consisting of two units each handling 2 million cubic feet of gas per day, has been in operation since May 1957. During this time the organic sulphur content of the gas has been consistently reduced to less than 6 grains per 100 cubic feet.

FOUNDED 1850 HOLMES HUDDERSFIELD

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Ltd., Birmingham, during the rolling of nickel alloy billets which had been re-heated in an open type furnace fired with town gas. Accordingly a plant was installed in 1943 having a rated capacity of 12,000 cu.ft. of gas per hour which was subsequently enlarged in 1949 to 25,000 cu.ft. per hour. Both the original and enlarged plant included the usual features, but in addition, provision was made for the plant to be kept in operation all the time and to handle extremely variable gas loads which were occasioned by the reheating furnace programme. This was done by fitting a recirculating valve on the line between the Holmes-Maxted plant and the furnaces, and connecting it by a recirculation main to the inlet boosters. If the load on the plant was reduced or removed (*e.g.*, if some or all the furnaces using desulphurised gas were shut down) the pressure at the plant outlet rose and the recirculation valve opened, allowing gas to recirculate back to the inlet booster. This ensured that there was at all times a flow of gas through the plant maintaining the heat exchanger and catalyst bed at the working temperature, and available for instant operation.

In contrast with the smaller plants, in which a static bed of catalyst is charged and discharged as a whole, that on the Wiggin Street plant is passed through in a semi-continuous manner, by discharging 0.4 cu.ft. of fouled catalyst from the bottom of the bed each day, and replacing it by the same volume of fresh catalyst at the top.

Air Cooling

A second plant was ordered by Henry Wiggin & Co., Ltd., for their Hereford works in 1954. This is of more modern design and actually consists of two plants each having a capacity of 30,000 cu.ft. per hour. The catalyst bed of each plant is cylindrical instead of annular, as on the Wiggin Street plant, and final gas cooling is done by a shell-and-tube heat exchanger, with air as a cooling medium around the tubes, instead of a washer cooler irrigated by water. This plant has treated 377 mill. cu.ft. of gas since it was commissioned in January, 1954, and there have been no catalyst or oxide renewals.

The following data relate to the two plants since operations began:[8]

WIGGIN STREET

Products: Nickel alloys in sheet, bar, rod and wire form.

Operations on which desulphurised gas used:

(a) Reheating of billets for rolling.

(b) Reheating of machined ingots for rolling.

Catalyst plant installed: 1943, enlarged 1949.

Rated capacity: 12,000 cu.ft. per hour, then 25,000 cu.ft. per hour.

Average rate of gas during use: 18,000 cu.ft. per hour per day; 10,000 cu.ft. per hour per night.

Period of use: Continuous, idling only at weekends but not shut down.

Type of gas: cvr.

Whether debenzolised: No.

Inlet organic sulphur content (av.): 24 grains per 100 cu.ft.

Outlet organic sulphur content (av.): 6-8 grains per 100 cu.ft.

Maximum permissible organic sulphur: Not possible to state. Sulphur should be absolute minimum.

Vol. gas treated/charge of catalyst: 17 mill. cu.ft. approx.

Blockage occurs in the outlet heat exchanger tubes but no analyses are available. A by-pass has been fitted to allow of cleaning without shutting down. Catalyst is regenerated on site.

HEREFORD

Products: As Wiggin Street.

Operations on which desulphurised gas used:

(a) Reheating of sheet bar and sheet for rolling and annealing.

(b) Reheating of billets for extrusion.

Catalyst plant installed: 1954.

Rated capacity: 30,000 cu.ft. per hour.

Average rate of gas during use, 18,000 cu.ft. per hour.

Period of use: Continuous, idling over weekend but not shut down.

Type of gas treated: cvr and cwg.

Whether debenzolised: No.

Inlet organic sulphur content (av): 22-24 grains per 100 cu.ft.

Outlet organic sulphur content (av.): 5-7 grains per 100 cu.ft.

Maximum permissible organic sulphur: Low as possible.

Vol. gas treated per charge catalyst: 16.85 mill. cu.ft.

No blockage of the heat exchanger has occurred. The gas cooler is more satisfactory than the one at Wiggin Street. Originally the reduction in organic sulphur compounds was down to 2 to 4 grains per 100 cu.ft., but is now 5 to 7 grains.

(e) *Other Industrial Uses*

(a) Raw town gas was used by the Dental Manufacturing Co., Ltd., Blackpool on an automatic brazing machine used for the brazing of small tungsten carbide dental bur tips to steel shanks. The heating was carried out by pressurised town gas in conjunction with oxygen. As the area available for brazing was small (1 mm. diameter), the exclusion of impurities, particplarly sulphur, was advisable in order to get a high-class weld. A Holmes-Maxted plant has been in operation on this process for six years with satisfactory results. Recent changes in the design of burs to give a greater area has caused purification requirements to be less stringent, so this plant is not now in continuous operation.

(b) In general heat treatment work, and particularly when small furnaces are used, where a measure of cleanliness and freedom from scale are required it is customary to use raw town gas. On many occasions this is not possible due to the very high organic sulphur content. This not only affects the element winding of the furnace, but also the work being treated. A small Holmes-Maxted plant was installed to treat gas supplying six Wild-Barfield furnaces in which small steel parts were being treated. The furnace makers reported that a considerable improvement was noted immediately the plant was commissioned and that this improvement was maintained.

(c) Work is being carried out at the present time in conjunction with the Cleckheaton district on the effect of organic sulphur removal from gas used during the bright annealing of wire in ' top hat ' furnaces. This work has not advanced sufficiently for a report to be made.

Conclusion

It should not be considered that the cases given above represent an exhaustive list of available applications of sulphur removal. It is possible that the industrial gas engineer has encountered others in the course of his duties. What is important, for the gas industry, is that he should be aware that a well-tried process of sulphur removal exists, and has been in operation under works conditions for the past 15 years. No figures of performance are available from many of the installations, for the simple reason that technical control by skilled technicians is not necessary. Results are observed on the work or the ware itself.

Acknowledgments

The author wishes to thank the Directors of W. C. Holmes & Co., Ltd., for permission to publish this paper. He gratefully acknowledges the assistance of the staffs of many firms, more particularly Mr. W. Merrett (Henry Wiggin & Co., Ltd.), Mr. S. R. Eveson (Thos. Webb & Sons Ltd., Stourbridge); Dr. F. W. Haywood (Wild Barfield Electric Fur-

naces); Mr. H. P. Killick (The Dental Manufacturing Co., Ltd.), and the Directors of their respective companies for permission to use results obtained.

REFERENCES

[1] The Removal of Sulphur Compounds from Town Gas by Catalytic Hydrogenation. E. B. Maxted and J. J. Priestley 'GAS JOURNAL,' March 20, 27 and April 3, 10, 1946.

[2] Organic Sulphur in Town Gas and their Removal. J. J. Priestley and H. Q. Marris. *Gas Times, 50,* 396-9 (1947).

[3] Reducing the Sulphur Content of Town Gas. J. J. Priestley. *Gas Times,* October and November, 1957.

[4] The Case for Organic Sulphur Removal. F. Broomhead 'GAS JOURNAL,' *293* 215-7, (1958).

[5] Br. Pat. No. 593,253.

[6] S. R. Eveson private communication.

[7] The Use of Town Gas in the Processing of Glass Tableware. *Gas Times,* February 3, 1945.

[8] Controlled Atmospheres for the Heat Treatment of Metals. Ivor Jenkins (London, Chapmans & Hall, 1951) p. 503.

[9] W. Merrett, private communication.

Continued from p. 20.

The 'Barson' circular sawing machine, metal-cutting hand shears, tube-bending machines, and the 'Roll-Ruler,' a practical instrument for exact drawings, were also seen.

Rozalex Ltd., showed their range of barrier creams and skin-conditioning preparations for eliminating occupational skin diseases in industry and among professional people whose work involves handling skin irritants. The newer types of Rozalex barrier creams formed an important feature of the exhibit. The Rozalex dispenser, for controlled issue of Rozalex creams, literature and clinical samples were made available for test purposes.

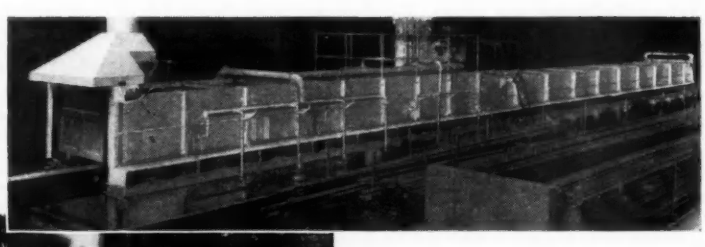
Spencer-Bonecourt-Clarkson Ltd., featured their 'Steambloc' Model 180 fully automatic packaged boiler, having a rating of 4,500 lb. steam per hour, and their Clarkson Bato/100 packaged boiler, which is of the vertical type.

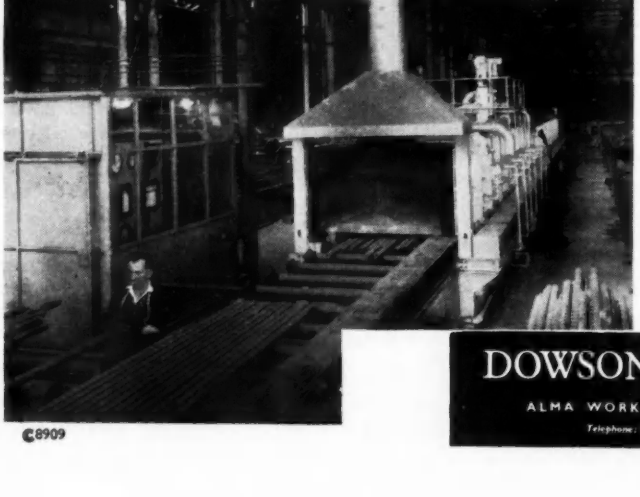
The Clarkson Hato/45 packaged-type hot-water boiler suitable for small central-heating plants, and Clarkson flue economiser also formed part of the exhibit, while a sectionalised scale model of a 'Steambloc' Model 400 unit rated at 10,000 lb. steam per hour illustrated constructional details.

Among manufacturers of respirators were the **Aerograph Co., Ltd.; Aerostyle Ltd.; The Butterley Co., Ltd.; W. F. Johnson & Co. (London) Ltd.;** and the **Martindale Electric Co., Ltd.** The last-named Company also exhibited their protective clothing and headgear, and other safety equipment.

Other exhibitors of manufactures of this class included: **British Nylon Spinners Ltd.; Fryer Textiles Ltd.; Harrimonde Ltd.; T. J. Lawton & Co. (Manchester) Ltd.; Linen Replacement Services Ltd.; London Towel Cabinets Ltd.; Northide Ltd.; John Peck & Co. Ltd.; Practical Uniform Co. Ltd.; R.F.D. Co. Ltd.; Scaffolding (Gt. Britain) Ltd.; Supercraft (Garments) Ltd.; Vulcascot (Gt. Britain) Ltd.; Jablo Plastics Industries Ltd.; E. P. Barrus (Concessionaires) Ltd.; G. A. Brooks, Partners Ltd.; The C. N. Oil Burner Co. Ltd.; Giles & Hooper; Parmelee (G.B.) Ltd.; The Silvaflame Co. Ltd.; Farrow & Jackson Ltd.; Geo. H. Gascoigne, Co. Ltd.; and Purdy Machinery Co. Ltd.**

ROLLER HEARTH FURNACE





The illustrations show a Roller Hearth Furnace having internal dimensions of 4' 0" wide x 90' 0" long, installed in the Tube Mill of Babcock and Wilcox Ltd., at Dumbarton.

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Losses to Oil Outweighed by Gas Gains

Claims RICHARD M. CURRIE, A.M.Inst.Gas E., in this extract from 'Selling Industrial Gas,' a paper to the Scottish Western Junior Gas Association.

COMPETITION from fuel oils only arises as a result of the comparison made by the consumer between the net costs of the two fuels. This difference is not, of course, the whole answer, and where we are in a position to discuss the other relevant factors, the business can normally be obtained in face of this comparison, for many processes. The known losses to fuel oil, in recent years have been confined to central heating installations and are of minor consequence compared with the conversions from fuel oil to town gas which have been obtained in the same period. The advantages of town gas of being easily controlled, capable of being burned with high efficiency at all temperatures, requiring no storage, etc., are not only paper advantages, but are vital to the consumer's interest in modern production plant. Nevertheless, the amount which he is prepared to pay per therm for the advantages of the refined fuel is to the greatest extent, intimately linked with his process.

For instance, a process requiring accurate temperature and/or atmospheric control can hardly be compared with a process involving a crude heating operation where little more is required than the evolution by the fuel of large quantities of heat within a given space. In the latter case, the advantages of town gas are not so apparent; the manufacturer is not prepared to pay so much for them and the job of an industrial gas engineer becomes a little bit harder. A large potential consumption falls within this category and for this to be realised to our advantage, a more attractive price must of necessity be offered.

Consumer Service

A more important factor in relation to the fuel which is finally chosen by the consumer, is the number of industrial gas engineers available—in other words, upon the extent of the consumer service which can be rendered.

Because the maximum development of our business depends upon the consumer looking upon the industrial gas engineer as his consultant in fuel, rather than as a salesman, high pressure selling technique is a disadvantage. To gain the maximum business from the consumer, goodwill must first necessarily be established. Consumer service takes many forms. Any request for attention resulting from some problem or trouble after the meter outlet and not involving direct sales, is 'service.' Such jobs include complaints of excessive gas consumption, failure of controls to operate, poor gas pressure in the works, requests for information on improved burner equipment of existing plant, redesign of existing burner equipment, and submission of drawings where the consumer wishes to construct his own plant.

Typewriter Manufacture

For instance, a complaint was received from a typewriter manufacturer regarding poor supply to the site of precision burner equipment used for type setting. About 20 sets of this equipment were used in the one section of the works, an air/gas mixture being supplied to the burner heads. Accordingly pressure recorders were fitted on the meter outlet and these showed that the supply conditions were adequate. However, complaints were still being received and the job was passed to the Industrial Section for attention. The internal piping of the factory was found to be satisfactory and there was no apparent reason for the complaint.

The actual burner systems were then examined. The burner nozzles were supplied with an air/gas mixture, each burner being fitted with an ordinary tee-piece at the burner inlet. This tee-piece was used for the mixing of the gas and air but the gas and air connections were fitted on opposing legs of the tee—that is, the supply pipes were at 180° to one another. The maximum air pressure supplied to the mixer could be in the order of 15 p.s.i. depending on the chosen setting of each of the 20 operators on the air controls. The gas pressure was governed to 3 in. w.g. Each operator could thus exert a back pressure on the gas line as a result of his setting of the individual gas and air cocks. As no back pressure valves were fitted which could separate the burner systems, any one operator could upset the burner conditions experienced by the remaining 19. Although properly designed mixing tees may have given increased satisfaction for this type of burner equipment, an air/gas mixing machine supplying a pre-set mixture to the burners, which mixture control would be entirely out of the operators' hands, was considered to be a much more desirable alternative. Such a recommendation was therefore made to the firm and was accepted.

Unusual Complaint

Another example concerned the copper shop of a shipyard from which a telephone call was received to the effect that someone in an office in the yard had turned on a ring burner and only air had come out. Of course, this received immediate attention from the Industrial Section and an examination was carried out of all the gas-using equipment throughout the part of the works where this had occurred. It was found that an operator had fitted a valve on the mixture outlet of an air blast burner utilising low-pressure gas with air at 100 p.s.i. Although separate air and gas cocks were fitted, this valve had been incorporated as a convenience. The incident illustrates the importance of the back pressure valve normally fitted on the meter outlet when compressed or fan air is employed in conjunction with town gas.

THE current position with the Industrial Gas Sales Section of the Scottish Gas Board's Glasgow District, from which the author hails, is described in his paper as follows: 'Since April, 1957, plant having an estimated annual gas consumption of 146 mill. cu.ft. has been added and other plant having a total estimated gas consumption of 1,244 mill. cu.ft. per annum is at present under construction or awaiting delivery. Negotiations with several large consumers are also being actively pursued, where consumptions of several thousand mill. cu.ft. per annum in total are considered to be a realisable potential.'

The plant manager was very pleased with the service he had received from the Gas Board. Goodwill having been established, contact was continued with the consumer and as a consequence a large gas-fired stress relieving and normalising furnace and several pipe-bending machines, having a total gas consumption of approximately 15 mill. cu.ft. per annum, have

since been installed, replacing the fuel oil equipment previously used for these processes.

A complaint was received from a foundry that the gas consumption of their large annealing furnace was excessive and heat treatment conditions were poor, due to the existence of temperature gradient over the height of the furnace.

The furnace was 25 ft. long, 18 ft. wide, and 14 ft. high to the top of the arch, and the burner equipment consisted of air blast burners firing along the line of the arch on each side, the maximum gas consumption being in the order of 20,000 cu.ft. per hour. The waste gases were flued along each side at hearth level and led by a main central underground flue, provided with a main damper to the main chimney stack. The loading of the furnace was normally in the region of 40-55 tons of steel castings and these were placed in the cold furnace, brought up to 950°C., and soaked at this temperature for 6 hours. The burners were then turned off and the load allowed to cool in the closed furnace.

Industrial Staff Takes Over

In an endeavour to improve the performance of the furnace, the industrial staff took over its control on two of the overnight heating cycles. By standardising the air and gas pressures, reducing the excessive draught within the furnace chamber by the regulation of the chimney damper and adjustment of the air and gas valves, all accompanied by regular flue gas analyses, it was possible to ensure that good combustion was established. Upon the desired conditions being set up, the heating cycle was allowed to proceed throughout. A superior heating curve was obtained and heating became more even throughout individual castings during the time of heating to annealing temperature. The gas consumption of the heating cycle was effectively reduced by approximately 50,000 cu.ft. and the time of the cycle itself from 21 hours to 15 hours. The savings were, of course, entirely due to the increase which had been brought about in the efficiency of combustion.

This furnace, although originally fitted with motorised valves, in the main air and gas lines, was not capable of correctly utilising them for operation, probably because of improper regulation at some time. As a consequence the adjustment of the air and gas controls, and also of the main damper which had always been for manual operation, was entirely in the hands of the furnaceman. Thus at will, he was able to produce any condition which he himself wished and the consumer was being met with increasing gas consumptions for his process. The importance of correct air/gas ratios is now understood by the consumer and the linked control valves are again to be put into satisfactory operation.

The problem of the adjustment to the chimney damper still remains, but as the operator has nothing else to do but look after this one furnace during its night cycle and no manual labour is involved, it was suggested to the consumer that as an alternative to the fitting of a rather expensive furnace pressure controller, which would automatically operate the damper in the stack, a large draught gauge be installed at each end of the furnace calibrated in hundredths of an inch W.G. The operator would be provided with the given working figure of draught required and as the pull in the furnace increased with rise in temperature, he would make the necessary alterations to the chimney damper. This principle has already been adopted for two weeks and has been found perfectly satisfactory; the saving which we managed to establish is still being obtained.

Recently, we were asked by an engineering firm to recommend suitable burner equipment for a soft metal melting bath, 3 ft. 0 in. long, 1 ft. 8 in. wide and 1 ft. 3 in. deep, to be operated at a temperature of 620°F.; the level of the metal in the bath was 10 in.-12 in.

First, the job was tackled in a general form, and since this was considered to be low temperature work where no great speed of combustion would be required, we thought in terms of the standard bar burner, fitted with Bray industrial jets. Consideration was then given to means of conserving the heat and it was decided to house the bath in insulating refractory.

On establishing these general points, the hourly gas consumption of the burners was calculated, having regard to the heat required by the bath, the load and the refractory setting. From this prepared data, it was possible to design the two bar burners fitted with industrial jets. Consideration was then given to the air supply to the burners and the fluing of the gases. A baffle brick was incorporated at the entrance to the flue offtake to prevent the hot gases flowing directly to the flue, which would result in uneven heating of the bath, and to ensure adequate scrubbing of the bath by the gases. A damper was incorporated in the primary flue and a down draught diverter fitted.

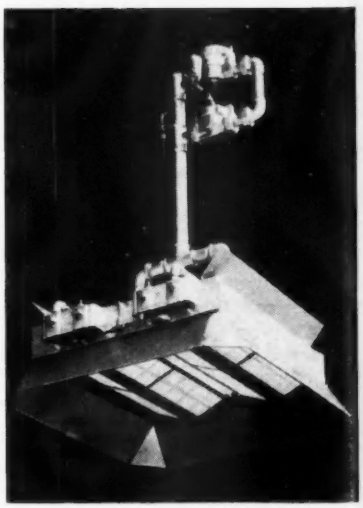
The burner controls included a low pressure governor to ensure constant thermal input and thermo-electric flame failure valves to afford protection against flame failure and provide safety in lighting up.

A detailed drawing, showing our proposals was forwarded to the consumer, together with a quotation for the burner equipment. It was intended that this bath should be controlled manually, so temperature control equipment was not included, although it is ideally suited for such an installation.

Overhead Radiant Heaters Now Operate on L.P. Gas

THE heating of commercial and industrial premises in areas not served by town gas has hitherto been a problem, particularly where intermittent heating was required.

For many years overhead radiant heaters, which were introduced by Radiant-Heating Ltd., of London, N.1, have become extremely popular throughout the country for space heating with town gas.

Overhead radiant heaters are now designed to operate on liquid petroleum gases—butane or propane—and heaters are available in various sizes for either wall mounting or suspension at varying heights of from 10 ft. to 50 ft.

Liquefied petroleum gases are available from Bottogas Ltd. (controlled by Shell-Mex and B.P. Ltd.). Delivery is made by road tankers and the gases are stored on site in 5-ton high pressure cylinders. Propane can be stored outside a building in all weathers. Alternatively, for smaller installations, replaceable bottles are available.